UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

OPEN-FILE REPORT O-93-4
PRELIMINARY GEOLOGIC MAP OF THE CROWLEY QUADRANGLE
MALHEUR COUNTY, OREGON
1993
BY MARK L. FERNS/CHRISTOPHER WILLIAMS

CROWLEY 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

UTM GRID AND 1972 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET

OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

Field work conducted 1992

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

QUADRANGLE LOCATION

CROWLEY, OREG.
N4315—W11752.5/7.5
1972
AMS 2470 IV SW—SERIES V892

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This unpublished Open-File Report has not been reviewed and may not meet all Oregon Department of Geology and Mineral Industries' standards.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 1992
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^{O} by 2^{O} Boise sheet, eastern, Oregon.

MINERAL RESOURCES

Mineral resources may occur in the quadrangle. Gem-quality, pale yellow labradorite crystals which yield flawless fragments as much as 5 grams in weight can be found in places weathering from the lowermost Tbmv flows near Whiskey Springs. Small thundereggs (2 cm in diameter) can be found near some of the faults that cut the Trsm rhyolite.

Potential for epithermal gold resources within the quadrangle appears rather slight. Slightly anomalous gold was detected in one sample of silicified rhyolite (BAB-201) along one of the northwest-trending faults along the north face of Stockade Mountain. These small areas of hydrothermal alteration are part of the southern extension of a larger mineralized zone that lies to the northwest of the quadrangle. Alteration intensifies along the fault to the northwest, to the Stockade Mountain prospect, where a large, subeconomic gold resource has reportedly been identified.

A second area of possible interest occurs on the south flank of Star Mountain, where a fault-bounded graben block of weakly altered Trsm rhyolite is cut by widely spaced, narrow and discontinuous pods and lenses of chalcedonic quartz. The rhyolite here has taken on a slight reddish tinge due to alteration of vitrophyre and lithoidal rhyolite. Alteration seems most intense along the southern boundary fault, which is not exposed.

GEOLOGICAL SUMMARY

The map area lies along the western edge of the Ore-Ida Graben (Ferns and others, 1993a, b). Oldest rocks exposed in the quadrangle are aphyric and plagioclase-phyric basalts (Tbmg) which form a section over 250 meters thick. Two different lithologies are exposed on Road Canyon; a lower unit made up mainly of aphyric basalts/andesites; and an upper unit made up of interbedded aphyric and (predominantly) coarsely plagioclase-phyric flows similar in chemistry and petrography to the Steens Basalt of Fuller (1931). Both lithologies appear as flows and autobreccias with intervening weathered zones underlain by palagonitized tuffs.

The unit is part of the extensive middle Miocene tholeiitic flood basalt province that cover much of eastern Oregon and lies in the transition zone between the plagioclase-phyric Steens Basalt to the south and the more voluminous Columbia River Basalt Group to the north. Abundance of palagonitized autobreccias and tuffs suggest that the flows at Road Canyon interacted with water.

An erosional unconformity separates Tbmg and Tr from younger volcanic units. Calc-alkaline basaltic andesite and andesite flows (Tba) erupted from vents (Tav) to the north. Ttcy, the Wildcat Creek Welded Ash-Flow Tuff (Kittleman and others, 1965, 1967) erupted from a vent to the northwest, following the main pulse of calc-alkaline volcanism.

Younger rhyolite flows and ash-flows (Ttsm, Tsmr, and Trsm) erupted from a vent in the north central part of the quadrangle. The rhyolites and tuffs partially fill a small collapse-structure which formed at about 12 Ma. Rhyolites are noteworthy in that they contain unusually low amounts of barium and strontium (<10 ppm Ba and Sr for Ttsm and Tsmr). Small volumes of ferrolatite (Tif) erupted shortly after the last of the rhyolites, followed by renewed tholeiitic magmatism (Tbmv).

Parts of the map area were covered by the distal edge of the Devine Canyon Ash-Flow Tuff (Ttdv) at about 9.2 Ma. Northeast-trending block faults developed following eruption of the Devine Canyon Ash-Flow Tuff, forming the north escarpment of Stockade Mountain.

Large pluvial lakes (Qss and Qsl)) covered much of the quadrangle in the late Pleistocene. The sand and gravel facies (Qs) mark the north shoreline of the large pluvial Turnbull Lake, which extended to the southwest. This lake partially-filled a large, northeast-trending late Tertiary structural basin that formed along the east edge of the Steens Mountain.

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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 • BAB-301

Location of mineralized sample analyzed in Table 2 • BAB-208

Qal Alluvium (Quaternary) Unconsolidated deposits of sand and gravel along modern stream channels.

Qf Alluvial fan deposits (Quaternary) Mainly unconsolidated and poorly sorted accumulations of coarse gravel deposited along the flanks of Cedar Mountain. Includes deposits of colluvium and slope wash along the north flank of Burnt Flat.

Qs Lacustrine sediments (Quaternary) Mainly unconsolidated lacustrine deposits of light colored fine sand and silt, may include evaporite deposits.

Ttdv Tuffaceous siltstones, sandstones, and ashflow tuff (upper Miocene) Mainly pale yellowish-white to white, tuffaceous siltstones. Includes a light gray vitric welded ashflow tuff about 3 feet thick which is locally exposed near the top of the unit. Ashflow contains less than 1% lithic fragments and about 3% sanidine and quartz phenocrysts approximately 3mm in diameter. Accessory minerals include a green pleochroic clinopyroxene. The ashflow is peralkaline with normative acmite (Analyses BAB-304, Table 1) and is chemically and petrographically identical to the 9.2 Ma Devine Canyon Tuff mapped by Greene (1973) west of Crowley.

Tbmv Mafic flows of Mooreville (Middle - Late Miocene) Bluish-black to bluish-gray, platy tholeiitic andesite, basaltic andesite, and basalt flows. Includes distinctive glomeroporphyritic flows with plagioclase phenocrysts as large as 2 cm in diameter, plagioclase and orthopyroxene glomerocrysts, and rare quartz xenocrysts. At least three flows with an aggregate thickness of 200 feet exposed in the Mustang Butte quadrangle to the south. Upper flows include diktytaxitic olivine basalts. Unit includes tholeiitic basalts (Analyses BAB-301, 310, Table 1) and ferro-andesites (Ferns, 1992).

Tif Ferrolatite (Middle to Late Miocene) Bluish black, coarsely phyric, porphyritic vitrophyre of ferrolatite composition. Unit is a single flow, with about 20% phenocrysts as large as 2 cm in diameter. Phenocrysts and/or xenocrysts are commonly partially resorbed and include plagioclase, potassium feldspar, augite, orthopyroxene, and olivine. Flow is a ferro-latite in composition (Analyses BAB-305, 308) with about 65% SiO_2 and 4% K_2O. Chemically and petrographically similar to the ferrolatite at

Fangollano (Ferns and Williams, 1993) and the Square Mountain ferro-latite (Bonnichsen and others, 1988). Flow erupted from feeder dike on southwest flank of Star Mountain.

Ts Tuffaceous sediments (middle or upper Miocene) Poorly exposed tuffaceous sandstone, siltstone, and conglomerate. Conglomerate contains rounded to angular clasts of rhyolite and chalcedonic quartz.

Trsm Porphyritic rhyolite flows and domes at Star Mountain (middle Miocene) Purplish gray to gray porphyritic rhyolite flows exposed at Star Mountain. Sanidine-phyric, metaluminous rhyolite flows with well developed carapace vitrophyre breccias. Individual lava flows marked by basal vitrophyre zones. Includes low-silica rhyolites (70% to 71% SiO_2; 13.1% to 13.4% Al_2O_3) with 5% to 10% plagioclase, sanidine, hypersthene, and augite phenocrysts and high-silica rhyolites (76% SiO_2, 12.1% Al_2O_3) with sanidine, plagioclase, and quartz phenocrysts (Analyses BAB-306, 307, Table 1). Intrudes and overlies the Wildcat Creek Welded Ash-Flow Tuff west of Road Canyon. Middle Miocene age based on stratigraphic position beneath flows of unit Tbtu.

Ttsm Welded Ash-Flow Tuff (middle Miocene) Light gray to pinkish-gray welded ash-flow tuff with phenocrysts of sanidine and plagioclase. Tuff also contains sparse olivine and orthopyroxene phenocrysts. Along the crest of Stockade Mountain, includes spherulitic, densely welded ash-flow tuff with rotated phenocrysts. Chemically a high-silica rhyolite characterized by unusually low Ba (<50 ppm) (Analyses BAB-302, 303).

Tsmr Rhyolite at Stockade Mountain (middle or upper Miocene?) Pinkish-gray to gray, spherulitic, porphyritic rhyolite typified by steeply-dipping, northwest-striking bands of 5 cm-diameter lythophysae. Characteristically consists of 5% phenocrysts (sanidine and plagioclase) as much as 6 mm in diameter in a cryptofelsitic groundmass containing radiating clots of chalcedony and opaques. Also contains sparse orthopyroxene and altered olivine phenocrysts. Chemically a metaluminous, high-silica rhyolite with 76%- 77% SiO_2 and exceptionally low Ba (Analysis BAB-326, Table 1). Bands of lithophysae dip steeply to the south and strike consistently to the northwest for 5 km along the north flank of Stockade Mountain. Rotation of originally subhorizontal emplacement boundaries to a near-vertical attitude is considered by Bonnichsen and others (1988) as evidence for plastic deformation and rheomorphic flowage. Part of unit Tvs of Walker and MacLeod (1991). Conformably overlain by Ttsm ash-flow without discernable erosional break and considered to be a rheomorphic ashflow that is closely related to overlying Ttsm. Unconformably overlain by flows of unit Tbtu. Middle and late Miocene based on presumed correlation with rhyolites to the west which have a radiometric K/Ar age of 11.3 Ma (Greene and others, 1972; and Fiebelkorn and others, 1982).

Ttcy Wildcat Creek Welded Ash-Flow Tuff (middle Miocene?) Pale red to grayish-red and light gray, welded lithic ashflow tuff. Mainly crystal-poor, with sparse phenocrysts of sanidine, plagioclase, and clinopyroxene. Typically contains abundant flattened pumice clasts. Chemically a low-silica peralkaline rhyolite with 400 ppm Zr (Analyses BAB-313, 314, Table 1). Underlies the rhyolite of Star Mountain on the west side of Road Canyon. Considered to be part of the Wildcat Creek Welded Ash-Flow Tuff as defined by Kittleman and others (1965, 1967) on the basis of similarities in chemistry. Includes parts of the unnamed tuffs near Crowley as mapped by Kittleman and others (1965, 1967).

Tay Mafic vent complex (middle Miocene) Poorly consolidated accumulation of red and black scoria and cinders with interbedded lava flows. Scoria includes black and red bombs up to 1 meter in thickness. Unit includes interbedded lava flows and is interpreted to be a vent for the Tba flows to the north. Associated lava flows at the vent are high silica basalts (Analyses BAB-321, Table 1).

Tba Basalt, basaltic andesite and andesite flows (middle to upper Miocene) Mainly red-weathering, gray to bluish-gray, sparsely phyric, holocrystalline lava flows. Includes trachytic andesite flows with plagioclase and rare olivine and clinopyroxene phenocrysts and pilotaxitic andesite with orthopyroxene microphenocrysts. Unit is made up of calc-alkaline lava flows ranging from high-silica basalt (SiO_2 > 52%) to high-silica andesite (62% SiO_2) (Brooks, 1992, Analyses BAB-315, Table 1). Includes at least 3 flows exposed northeast of Turnbull Mountain, where unit is about 200 feet thick and unconformably overlies middle Miocene basalts of unit Tbmg. Middle Miocene age based on stratigraphic position beneath Barstovian vertebrate locality near Skull Springs, north of the quadrangle boundary. (Kittleman and others, 1965). Unit is correlative in part with the "unnamed igneous complex" of Kittleman and others (1965, 1967) and may be equivalent to the "red andesite" unit mapped by Brooks (1992) in the Rufino Butte quadrangle to the northeast.

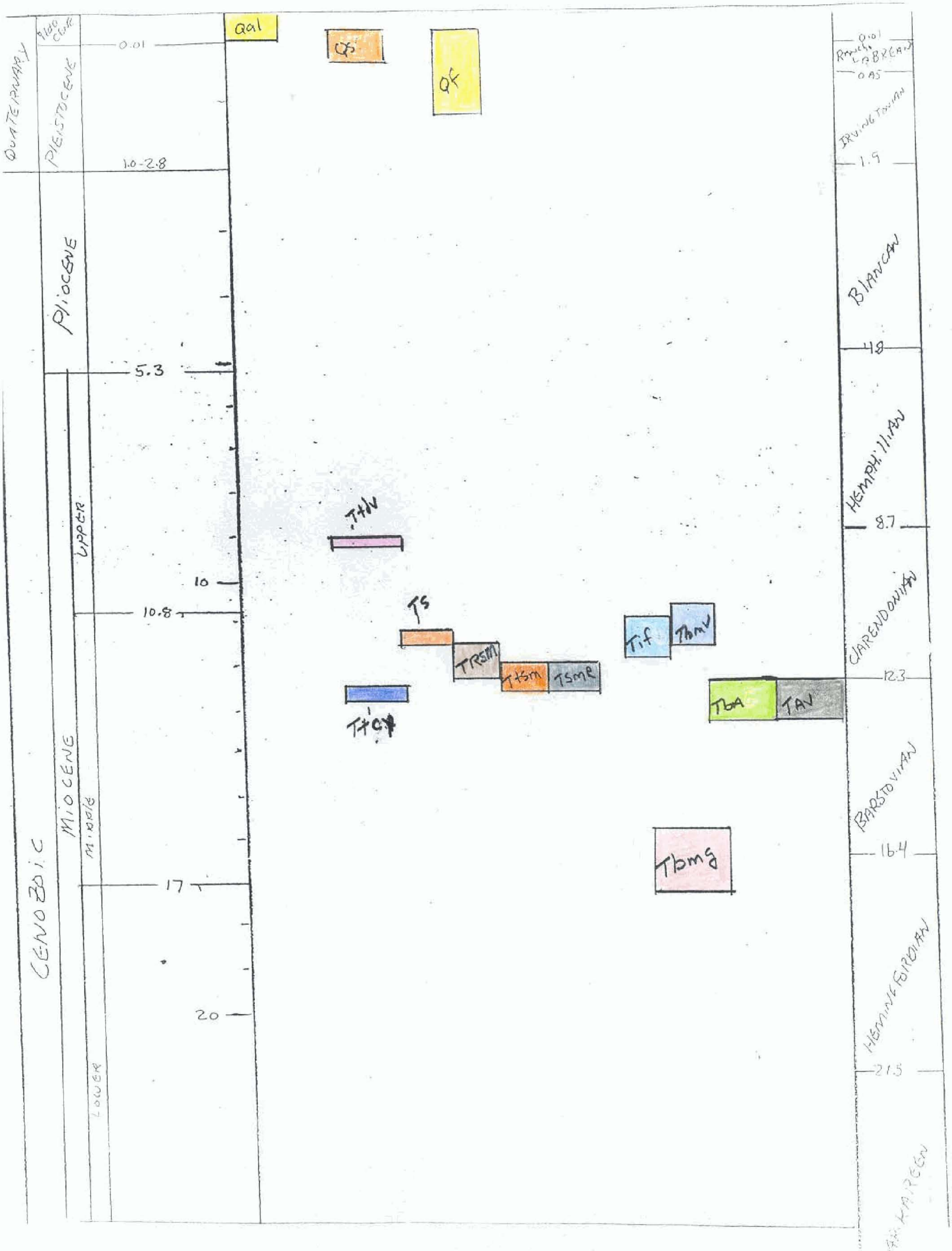
Tbmg Basalt of Malheur Gorge (middle Miocene) Dark-gray, coarsely plagioclase-phyric lava flows and autoclastic breccias that weather to various shades of red and brown and form ledges 3 to 12 m thick. Includes massive basalt, platy basalt, and vesicular, glassy basalt breccias. Lower part of section on Road Canyon includes coarsely plagioclase-phyric basalt flows with as much as 50% plagioclase phenocrysts as long as 2.5 cm. Stratigraphically higher flows at Road Canyon are platy and aphyric. Includes holocrystalline and hyalocrystalline flows with sparse phenocrysts of plagioclase (labradorite), olivine, and ilmenite. Over 250 m of flows with interbedded palagonitic sediments are exposed on Road Canyon where the unit includes thin, lenticular deposits of subaerial tuff and scoria. Coarsely plagioclase-phyric flows on Road Canyon contain about 47.8% to 49% SiO_2, 17.0% to 20.1% Al_2O_3, and 9.2% to 12.0% Fe_2O_3 (Analyses BAB-324, 325, Table 1). Middle Miocene age based on K/Ar dates of about 15.5 - 17 Ma (Fiebelkorn and others, 1982). Western exposures are correlative with the Steens Basalt of Fuller (1931), the "unnamed igneous complex" of Kittleman and others, (1965, 1967) and the basalt of Malheur Gorge of Evans (1990).

Table 1 Major and Trace Element Analyses for Unaltered Rocks, Crowley Quadrangle 0-93-4

LAB #	1/4	1/4	Sec	T.S.	R.E.	Elev.	Lithology	Map Unit	SiO2 %	Al2O3 %	TiO2 %	Fe2O3 %	MnO %	CaO %	MgO %	K2O %	Na2O %	P2O5 %	LOI %	Cr ppm	Co ppm	Ni ppm	Cu ppm	Zn ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm	Ba ppm	[illegible] ppm
BAB-301	SW	NE	32	26	39	5300	Basalt	Tbmv	47.6	15	2.51	13.9	0.21	3.73	5.45	1.15	2.79	0.82	0.25	57	44	57	36	127	30	393	26	206	43	[illegible]	13
BAB-302	NE	SE	24	26	38	5520	Tuff	Ttsm	77.5	7.98	0.11	1.22	0.03	0.43	0.11	3.92	3.33	0.03	0.85	<1	5	3	2	72	128	<10	44	368	71	11	14
BAB-303	NE	SE	13	26	38	4740	Tuff	Ttsm	76.3	11.3	0.11	1.13	0.03	0.47	0.09	4.43	3.65	0.04	0.75	<1	6	4	3	78	161	<10	62	639	69	27	4[illegible]
BAB-304	SE	NE	17	26	39	4480	Welded tuff	Ttdv	73.4	10.7	0.23	2.84	0.08	0.54	0.17	5.22	3.01	0.05	3.25	1	7	[illegible]	5	258	139	<10	189	1170	134	79	19
BAB-305	NE	NE	17	26	39	4280	Ferrolatite	Tlf	65	12.8	1.11	5.79	0.1	2.69	1.55	4.01	2.87	0.28	2.7	16	21	26	11	72	148	135	20	306	45	518	56
BAB-306	NW	SE	7	26	39	4340	Rhyolite	Trsm	75.8	12.1	0.07	1.09	0.03	0.33	0.1	4.35	3.97	0.05	0.35	<1	1	2	7	136	254	<10	33	191	96	46	24
BAB-307	NE	NW	29	25	39	5880	Rhyolite	Trsn	71.2	13.4	0.34	2.55	0.06	1.46	0.39	4.52	3.23	0.09	2.6	<1	4	[illegible]	5	42	136	128	35	223	35	1100	17
BAB-308	SW	NW	5	26	39	5400	Ferrolatite	Tlf	62.9	13.1	1.46	7.37	0.1	3.66	1.97	3.4	2.94	0.36	2.2	13	21	33	54	85	112	139	52	291	43	466	22
BAB-309	NE	NW	29	26	39	4420	Rhyolite	Trsn	69.5	13.1	0.36	2.32	0.06	1.46	0.39	4.99	3.22	0.09	3.75	<1	6	5	5	47	145	133	40	344	32	1350	20
BAB-310	NW	NE	27	26	39	4260	Basalt	Tbmv	48.2	15	2.48	14	0.21	8.64	5.66	1.11	2.87	0.81	-0.25	95	39	64	23	127	39	389	31	310	50	805	11
BAB-313	NE	NE	35	25	39	4960	Welded tuff	Ttcy	77.8	9.37	0.363	1.12	0.03	0.56	0.15	2.81	3.42	0.05	2.55	26	2	3	5	36	35	67	36	313	31	375	[illegible]
BAB-314	NE	NE	35	25	39	4960	Welded tuff	Ttcy	68	13	0.65	4.51	0.05	0.97	0.35	2.71	4.42	0.19	2.1	41	9	9	10	98	90	105	58	429	52	1050	6
BAB-315	SW	NE	25	25	39	5200	Andesite	Tba	60.1	14.1	1.59	9.34	0.19	4.6	1.69	2.59	4.07	0.42	0.9	25	17	11	46	126	77	318	50	335	41	1000	11
BAB-316	NW	SE	2[illegible]	2[illegible]	39	5250	Basalt	Tbmg	52.3	14.5	2.29	11.1	0.17	7.23	3.34	1.56	3.36	0.85	2.1	22	33	55	47	116	38	420	27	220	38	594	10
BAB-324	NE	NE	1	26	39	4460	Basalt	Tbmg	49.1	20.1	1.56	9.21	0.14	10.5	2.76	0.64	3.26	0.37	0.95	-	-	-	-	-	21	615	24	116	20	[illegible]	-
BAB-325	NE	NE	1	26	39	4440	Basalt	Tbmg	47.7	17.2	1.76	12	0.18	9.85	4.8	0.55	2.99	0.31	1	-	-	-	-	-	21	491	21	123	31	366	-
BAB-326	SW	SW	19	26	39	5200	Rhyolite	Tsnr	77.2	11.2	0.11	1.24	0.03	0.16	0.16	4.67	3.9	0.03	0.5	-	-	-	-	-	147	<10	57	296	44	[illegible]	-

MAP SYMBOLS

———	Contact -- approximately located
—•—— — — — ···	Fault contact -- dashed where approximately located, dotted where concealed. Ball and bar on down throw side
Y	Strike and dip of beds
X	Location of whole rock sample analyzed in Table 1
	Location of mineralized sample analyzed in Table 2



TIME ROCK CHART - CROWLEY

Table 2. Analyses of altered rocks

Laboratoy Number	1/4	1/4	Sec.	T.	R.	Lithology	Map Unit	Ag ppm	As ppm	Au ppb	Cu ppm	Hg ppm	Mo ppm
BAB-201	SE	NW	32	26	39	Silicified rhyolite	Tsmr	0.028	15.6	12	3.27	0.95	2.78
BAB-202	SE	NW	32	26	39	Silicified rhyolite	Tsmr	0.028	10.9	<1	3.42	0.123	1.64
BAB-203	NE	NW	19	26	39	Jasperoid	Tbmv	0.066	17.3	<1	5.7	<.1	2.01
BAB-204	SW	NE	19	26	39	Jasperoid	Tbmv	<.015	66.5	<1	15.6	<.1	1.15
BAB-205	SE	NE	19	26	39	Rhyolite	Tsmr	0.02	11.8	<1	2.77	0.132	2.68
BAB-206	SE	NE	12	26	38	Bleached rhyolite	Trsm	0.024	7.74	<1	4.65	0.19	1.48
BAB-207	SW	SW	32	25	39	Chalcedony	Trsm	<.015	<1.	<1	5.91	<.1	4.66
BAB-208	SE	SW	33	25	39	Chalcedony	Trsm	<.015	<1.	<1	4.62	<.1	4.16
BAB-209	NE	SE	9	26	39	Chalcedony	Trsm	<.015	1.52	<1	5.05	<.1	4.84

Laboratoy Number	Pb ppm	Sb ppm	Tl ppm	Zn ppm	Bi ppm	Cd ppm	Ga ppm	Se ppm	Te ppm	Ba ppm	Co ppm	Cr ppm	Fe %	Li ppm
BAB-201	3.62	6.46	<.5	48.2	<.25	<.1	<.5	<1	<.5	43	2	85	0.8	36
BAB-202	4.11	1.9	<.5	30.3	<.25	<.1	<.5	<1	<.5	21	4	68	0.66	12
BAB-203	4.6	0.942	<.5	24.9	<.25	<.1	<.5	<1	<.5	177	<1	94	1.03	50
BAB-204	0.948	0.729	<.5	29.6	<.25	<.1	<.5	<1	<.5	167	1	110	2.06	11
BAB-205	8.62	2.02	<.5	42.1	<.25	<.1	<.5	<1	<.5	56	1	77	0.71	6
BAB-206	7.49	2.35	<.5	22.8	<.25	<.1	<.5	<1	<.5	634	3	144	1.98	9
BAB-207	1.27	<.25	<.5	4.77	<.25	<.1	<.5	<1	<.5	38	<1	317	0.59	15
BAB-208	2.34	<.25	<.5	5.62	<.25	<.1	<.5	<1	<.5	49	<1	210	0.64	37
BAB-209	0.821	<.25	<.5	3.83	<.25	<.1	<.5	<1	<.5	45	<1	206	0.59	6