BRITISH COLUMBIA

PROSPECTORS ASSISTANCE PROGRAM

MINISTRY OF ENERGY AND MINES

GEOLOGICAL SURVEY BRANCH

PROGRAM YEAR:	1998/99
REPORT #:	PAP 98-20
NAME:	LLOYD R. NILSEN

Prospectors Assistance Program

Report on 1998 Project

by

Lloyd R. Nilsen

98/99 P41

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LLOYD R. NILSEN

6465 CLOVER ROAD
VERNON, BRITISH COLUMBIA V1B 3T7

Home Phone 250 545 0579
Fax 250 545 6536

TO: **Prospecting Assistance Program Coordinator**
SUBJECT: **Supplement to Summary of Prospecting Activities 98/99 Program**

The 1998 season was disappointing in that no significant new discoveries of precious opal were made, and no precious metal or base metal showings were located. The precious opal found near the Douglas Lake road appears to be very localized and of no commercial value. The discovery is at the north end of a section of agate bearing basalt that extends for 2 or 3 kilometers to the south and parallels the Douglas Lake road, but there is no opal to be found at any point along this zone apart from the small outcrop of lahar at the north end. The remainder of Area 2 is also disappointing in that the silica present is almost exclusively in the form of sugary quartz with relatively minor amounts of agate (with the one exception noted), and almost no opal. Perhaps the most interesting geology noted was slightly outside of Area Two on MT. Martin (NE of Monte Lake) where a zone of mixed lahar & tuff was discovered that is remarkably similar in every respect to the material that hosts Okanagan Opal's precious opal deposit. Although no precious opal was in evidence - the area clearly requires a more extensive review at some point in the future.

Two other excursions outside of Area One and Area Two were made. The first was to the Penticton area to do reconnaissance in the area of the Opalus claims which were staked by Penticton prospectors to cover an area where a piece of float heavily laced with precious opal was discovered many years ago. The area is of interest and may form part of a prospecting program at some time in the future. The other excursion outside of Areas One & Two was to the Watching Creek area north of Kamloops where reports indicate that interesting showings of opal have been noted. This was confirmed and the area may also warrant a program at some point in the future.

Area One did not yield any new discoveries of precious opal, but further trenching on the discovery zones on Taha 1 & 2 was productive in uncovering more opal and in shedding further light on the nature of the deposit. The precious opal is clearly concentrated in areas of greatest fracturing - probably no surprise as the fractures are obviously conduits for silica rich solutions. What is surprising is the amount of precious opal (quantity of pieces not size) that is present when rock is broken and excavated. There appears to be significantly more opal present that one would expect from observations of surface exposures. This is difficult to explain and points out the need to carry out a program of rock excavation as opposed to simply exposing bedrock by trenching overburden. Since most of the host rock is a very competent basalt this means some blasting will be required which is not desirable but appears to be the only practical way to get any exposure at some depth below surface outcrop. Rock broken to date has been by hammer and wedge a slow and arduous process! There is one area where the host rock is quite weathered and friable, but this area is mostly covered with a combination of talus and overburden and would require an extensive program of mechanical trenching as opposed to the hand trenching that has been carried out over the past two seasons. As for Area One as a whole one would hesitate to state that the area has been covered in enough detail to eliminate the possibility of further PO deposits. Some further reconnaissance prospecting is probably warranted.

Sampling and assaying costs for the season are significantly below the !0% of project costs that is a mandated minimum as outlined in the Prospectors Assistance Program. As pointed out in last years report the technique for evaluating Precious Opal is by methods other that assaying, and I made the necessary acquisition of an Opal Brightness Kit in 1997. I have attached the information on this technique again for your convenience.

Other sampling carried out in Areas One & Two did not return anomalous values of interest. Most of the sampling was carried out on quartz shears and stockworks that contained little or no sulfide and, as sampling confirms, little or no precious metals. The area is remarkably devoid of sulfide mineralization - even pyrite.

The weather (hot & dry) was generally much more favorable to prospecting for precious opal that was the case in 1997. It did, however, result in the forests becoming dangerously dry on some occasions, and prospecting had to be temporarily curtailed to avoid the risk of inadvertently starting a fire.

Total prospecting costs are below those required to trigger the full amount of the grant. There are, of course, other costs incurred in carrying out the program that are not included as they do not qualify under the terms of the agreement. Although I did meet the budgeted number of prospecting days I had hoped to significantly exceed this. I had also anticipated more extensive excavation work on the Taha discovery. For a variety of reason this did not happen. Most importantly my wife was diagnosed with cancer last spring. Despite this we decided that I should proceed with my program as best I could. As the result of complications arising from the cancer my wife passed away on December 8th, 1998.

BRITISH COLUMBIA
PROSPECTORS ASSISTANCE PROGRAM
PROSPECTING REPORT FORM (continued)

B. TECHNICAL REPORT

- One technical report to be completed for each project area.
- **Refer to Program Requirements/Regulations 15 to 17, page 6.**
- If work was performed on claims a copy of the applicable assessment report may be submitted in lieu of the supporting data (see section 16) required with this TECHNICAL REPORT.

Name LLOYD R. NILSEN Reference Number 98/99 P41

LOCATION/COMMODITIES

Project Area (as listed in Part A) AREA ONE MINFILE No. if applicable

Location of Project Area NTS 82 L/4 & 82 L/5 Lat 50°10' Long 119°45 (CENTER)

Description of Location and Access 40 K W/SW OF VERNON. ACCESS BY WHITEMAN CREEK FSR & SECONDARY BRANCHES. TAHAETKUN MOUNTAIN ON NORTH BOUNDARY - ROUNDTOP MOUNTAIN ON SOUTH.

Main Commodities Searched For PRECIOUS OPAL, GOLD & SILVER.

Known Mineral Occurrences in Project Area BRETT GOLD & WHITE ELEPHANT GOLD & SILVER ARE CLOSE TO EASTERN BOUNDARY.

WORK PERFORMED

1. Conventional Prospecting (area) 21 DAYS IN THE FIELD.
2. Geological Mapping (hectares/scale) PRELIMINARY ONLY.
3. Geochemical (type and no. of samples) —
4. Geophysical (type and line km) —
5. Physical Work (type and amount) 64 HOURS TRENCHING
6. Drilling (no. holes, size, depth in m, total m) —
7. Other (specify) 16 SAMPLES FOR ASSAY FROM AREA ONE.

SIGNIFICANT RESULTS

Commodities PRECIOUS OPAL Claim Name TAHA 1 & 2 & JOAN 3.

Location (show on map) Lat 50° 15' Long 119°43' Elevation ∝ 6100'

Best assay/sample type PRECIOUS OPAL WITH EXCELLENT FIRE.

Description of mineralization, host rocks, anomalies THE ACTUAL DISCOVERY WAS MADE PREVIOSLY BUT ADDITIONAL ZONES WERE FOUND IN 98/99 PROGRAM. THE PRECIOUS OPAL IS FOUND IN VESICULES & FRACTURES IN BASALT FLOWS & LAHAR BEDS. ALL SHOWINGS APPEAR TO UNDERLY FLAT LYING FINE GRAINED DARK COLORED FORMATIONS OF VOLCANIC TUFF. THE QUANTITY OF P.O. IS CLEARLY RELATED TO THE AMOUNT OF FRACTURING IN THE BASALT.

Supporting data must be submitted with this TECHNICAL REPORT

Information on this form is confidential for one year from the date of receipt subject to the provisions of the *Freedom of Information Act*.

BRITISH COLUMBIA
PROSPECTORS ASSISTANCE PROGRAM
PROSPECTING REPORT FORM (continued)

B. TECHNICAL REPORT

- One technical report to be completed for each project area.
- **Refer to Program Requirements/Regulations 15 to 17, page 6.**
- If work was performed on claims a copy of the applicable assessment report may be submitted in lieu of the supporting data (see section 16) required with this TECHNICAL REPORT.

Name LLOYD R. NILSEN **Reference Number** 98/99 P41

LOCATION/COMMODITIES

Project Area (as listed in Part A) AREA TWO MINFILE No. if applicable

Location of Project Area NTS 82L/5 Lat 50°25' Long 119°52' (CENTER)

Description of Location and Access CENTERED 50 K NW OF VERNON. CAN BE REACHED VIA HWY 97C TO THE WESTWOLD & MONTE LAKE AREAS. THE DOUGLAS LAKE ROAD AND FOREST SERVICE ROADS BISECT THE AREA.

~~Main Commodities Searched For~~ PRECIOUS OPAL - GOLD & SILVER.

Known Mineral Occurrences in Project Area NO SIGNIFICANT MINERAL OCCURENCES WITHIN, OR CLOSE TO, THE AREA.

WORK PERFORMED

1. Conventional Prospecting (area) 16 DAYS IN THE FIELD.
2. Geological Mapping (hectares/scale) —
3. Geochemical (type and no. of samples) —
4. Geophysical (type and line km) —
5. Physical Work (type and amount) —
6. Drilling (no. holes, size, depth in m, total m) —
7. Other (specify) 5 SAMPLES FOR ASSAY WITHIN (OR NEAR) AREA.

SIGNIFICANT RESULTS

Commodities PRECIOUS OPAL Claim Name NOT STAKED

Location (show on map) Lat Long Elevation

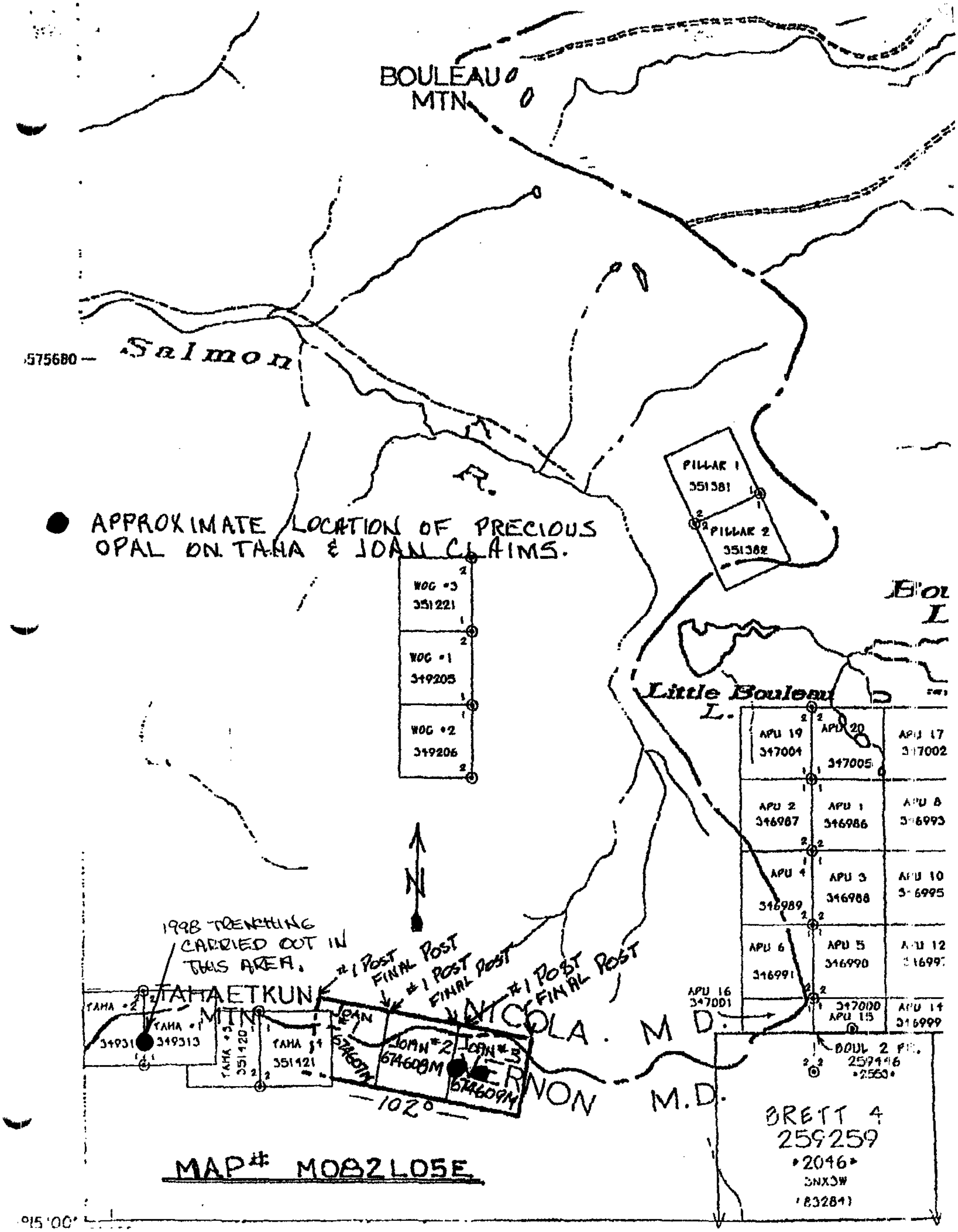
Best assay/sample type

Description of mineralization, host rocks, anomalies

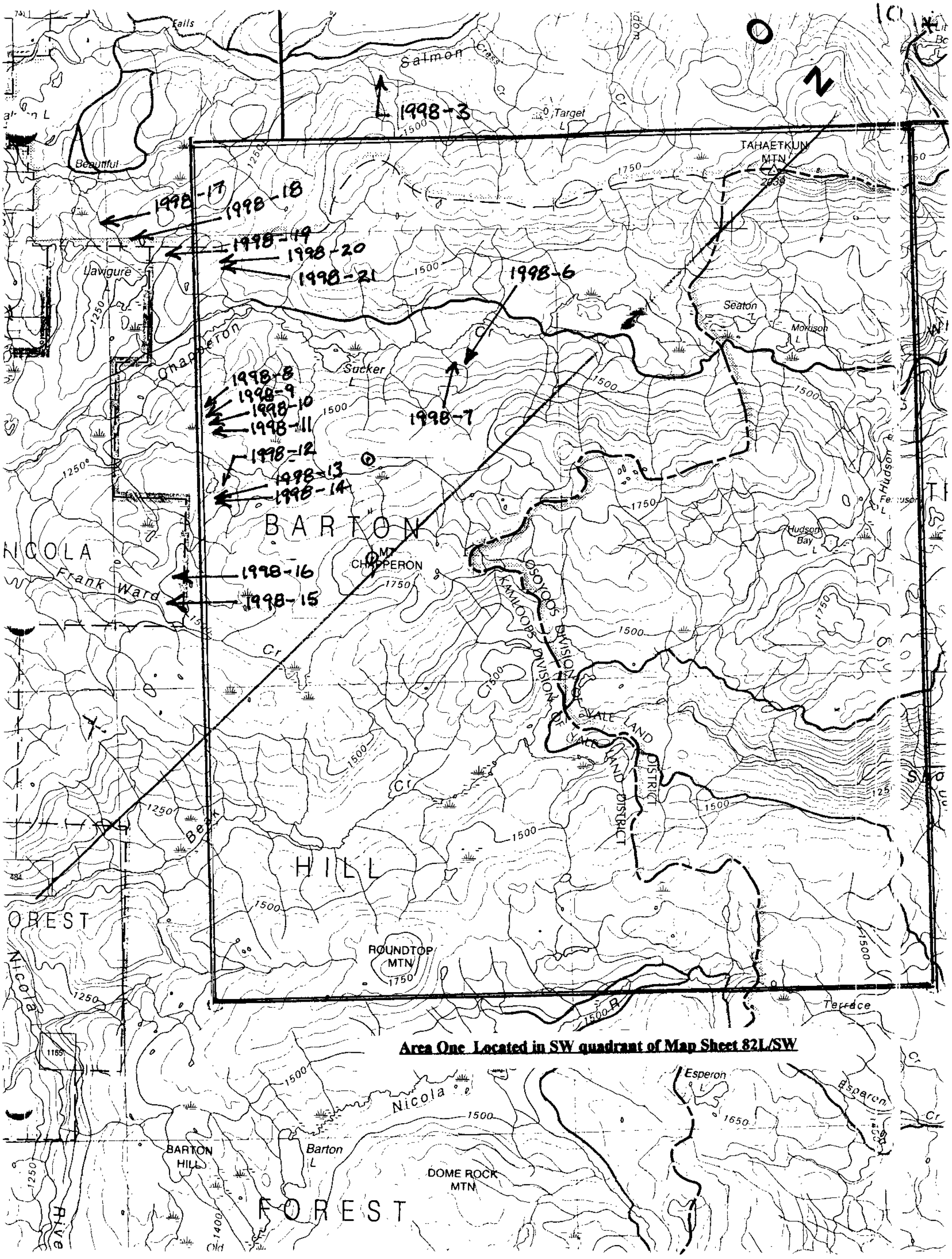
A VERY MINOR AMOUNT OF PRECIOUS OPAL WAS FOUND ABOUT 400 M ABOVE THE 11 K MARKER ON THE DOUGLAS LAKE ROAD. THE OUTCROP WITH THE P.O. WAS SMALL BUT THERE IS FAIRLY EXTENSIVE OUTCROP NEARBY IN ALL DIRECTIONS. EXTENSIVE PROSPECTING FAILED TO UNCOVER FURTHER OPAL.

Supporting data must be submitted with this TECHNICAL REPORT

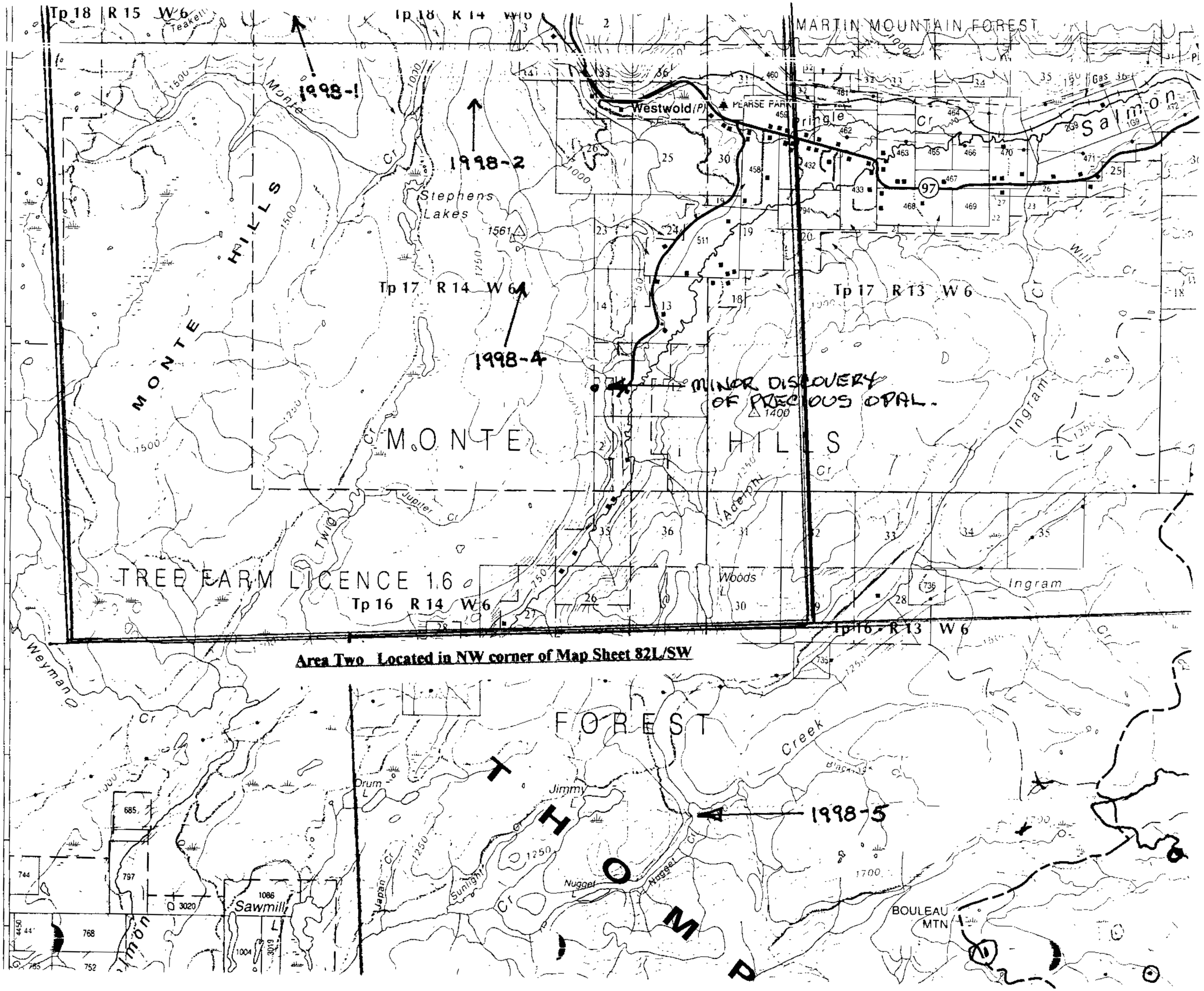
Information on this form is confidential for one year from the date of receipt subject to the provisions of the *Freedom of Information Act*.



BOULEAU MTN
Salmon R.
575680
APPROXIMATE LOCATION OF PRECIOUS OPAL ON TAHA & JOAN CLAIMS.
PILLAR 1 351381
PILLAR 2 351382
WOG #3 351221
WOG #1 349205
WOG #2 349206
Little Bouleau L.
APU 19 347004
APU 20 347005
APU 17
APU 2 346987
APU 1 346986
APU 8
APU 4 346989
APU 3 346988
APU 10
APU 6 346991
APU 5 346990
APU 12
APU 16 347001
347000 APU 15
APU 14
1998 TRENCHING CARRIED OUT IN THIS AREA.
#1 POST FINAL POST
#1 POST FINAL POST
#1 POST FINAL POST
TAHAETKUN MTN
TAHA #2
TAHA #1 349313
TAHA #3 351420
TAHA #4 351421
JOAN
JOAN #2 674608M
JOAN #3 674609M
NICOLA M.D.
VERNON M.D.
BOUL 2 FR.
102°
BRETT 4 259259 •2046•
MAP# MO82L05E



Area One Located in SW quadrant of Map Sheet 82L/SW



Area Two Located in NW corner of Map Sheet 82L/SW

1998 Sampling Results

Sample Number	Location	Rock Type - Description
1998 - 1	Area Two	Veined (qtz) granite stock off George Creek Road.
1998 - 2	Area Two	Lahar with qtz stockwork - 1/2 " veinlets.
1998 - 3	Area Two	Greywacke (?) - fractured fine grained Qtz & Ca & calcite veinlets & inclusions.
1998 - 4	Area Two	Lahar laced with sugary qtz & calcite.
1998 - 5	Area Two	Highly fractured & oxidized lahar with qtz
1998 - 6	Area One	Rusty shear zone through basalt.
1998 - 7	Area One	Rusty shear in opalized basalt.
1998 - 8	Area One	Rusty silicified shear in basalt.
1998 - 9	Area One	Shear zone with major qtz vein.
* 1998 - 10	Area One	Shear zone with major qtz vein. wk-mod Au-As-Pb-Zn (Cu)
1998 - 11	Area One	Green schist zone within qtz shear. wk-mod As-Sb
1998 - 12	Area One	Quartz vein with rusty fractures.
1998 - 13	Area One	Rusty shear zone - some quartz.
1998 - 14	Area One	Quartz boulders with rusty fractures.
1998 - 15	Area One	Rusty appearing lahar.
1998 - 16	Area One	Quartz vein.
1998 - 17	Area One	Basalt outcrop laced with qtz veinlets.
1998 - 18	Area One	Sheared siliceous gneiss.
1998 - 19	Area One	Sheared siliceous gneiss.
1998 - 20	Area One	Sheared siliceous gneiss.
1998 - 21	Area One	Sheared gneiss with rusty quartz veinlets.

1998 Precious Opal Samples: As in 1997 a large number of specimens of precious opal were recovered from the 3 discoveries on Tahaetkun Mountain. Brightness and color variety are excellent, but the small size of the individual 'stones' call into question whether or not these deposits have economic value. More extensive excavations will be required before that question can be definitively answered. Unfortunately this work was not completed in 1998 as had been planned!

29-Jun-98

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10041 East Trans Canada Highway
KAMLOOPS, B.C.
V2C 6T4

Phone: 250-573-5700
Fax : 250-573-4557

ICP CERTIFICATE OF ANALYSIS AK 98-221

L.R. NILSEN
6485 CLOVER RD.
VERNON, BC
V1B 3T7

No. of samples received:2
Sample type: Not given
PROJECT #: Not given
SHIPMENT #:Not given
Samples submitted by: Not given

Values in ppm unless otherwise reported

Et #.	Tag #	Au(ppb)	Ag	Al %	As	Ba	Bi	Ca %	Cd	Co	Cr	Cu	Fe %	La	Mg %	Mn	Mo	Na %	Ni	P	Pb	Sb	Sn	Sr	Ti %	U	V	W	Y	Zn
1	1998-1	5	0.4	0.87	<5	60	25	0.35	<1	7	73	81	1.94	<10	0.51	411	<1	0.05	4	480	4	5	<20	24	0.07	<10	37	<10	2	35
2	1998-2	5	<0.2	3.62	10	135	5	2.46	<1	26	21	23	4.89	10	2.12	869	<1	0.09	43	2450	8	10	<20	2400	0.13	<10	71	<10	10	61
QC DATA:																														
Resplit:																														
1	1998-1	5	0.6	0.82	<5	55	25	0.34	<1	6	87	78	1.88	<10	0.49	410	<1	0.04	5	480	4	<5	<20	19	0.06	<10	35	<10	2	34
Repeat:																														
1	1998-1	5	0.6	0.88	<5	60	30	0.36	<1	7	74	80	1.96	<10	0.51	412	<1	0.05	5	480	4	<5	<20	26	0.07	<10	37	<10	2	35
Standard:																														
GEO'98		125	1.4	1.80	55	150	5	1.71	<1	19	62	76	3.94	<10	0.95	665	<1	0.03	26	660	18	<5	<20	59	0.13	<10	79	<10	4	69

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B.C. Certified Assayer

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27-Aug-98

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Phone: 250-573-5700
Fax : 250-573-4557

ICP CERTIFICATE OF ANALYSIS AK 98-465

LLOYD NILSEN
6465 CLOVER ROAD
VERNON, BC
V1B 3T7

ATTENTION: LLOYD NILSEN

No. of samples received: 7
Sample type: Rock
PROJECT #: None Given
SHIPMENT #: None Given
Samples submitted by: L. Nilsen

Values in ppm unless otherwise reported

Et #.	Tag #	Au(ppb)	Ag	Al %	As	Ba	Bi	Ca %	Cd	Co	Cr	Cu	Fe %	La	Mg %	Mn	Mo	Na %	Ni	P	Pb	Sb	Sn	Sr	Ti %	U	V	W	Y	Zn
1	1998-3	5	<0.2	2.83	<5	410	10	7.66	<1	27	40	12	4.83	<10	3.74	674	<1	0.03	141	1640	2	5	<20	219	0.17	<10	103	<10	8	50
2	1998-4	5	<0.2	3.32	<5	45	15	4.79	<1	24	24	13	4.82	30	1.59	737	<1	0.30	24	2180	12	<5	<20	1750	0.38	<10	98	<10	20	63
3	1998-5	5	<0.2	1.79	<5	105	<5	1.52	<1	13	39	9	3.99	30	0.53	206	<1	0.08	10	2170	10	<5	<20	297	0.11	<10	143	<10	22	90
4	1998-6	5	<0.2	1.84	<5	110	<5	1.31	<1	36	187	19	6.22	20	1.31	539	<1	0.13	174	1870	14	<5	<20	147	0.11	<10	130	<10	18	64
5	1998-7	5	<0.2	1.37	<5	100	10	1.12	<1	26	147	20	5.41	10	0.35	636	3	0.12	103	2100	8	<5	<20	110	0.04	<10	116	<10	16	60
6	1998-8	5	<0.2	0.45	10	175	5	6.48	<1	9	90	19	3.05	<10	1.36	666	2	0.01	22	530	10	5	<20	367	0.03	<10	24	<10	2	31
7	1998-9	5	<0.2	1.28	110	10	5	5.20	<1	21	639	16	2.85	<10	4.02	793	1	<0.01	252	180	4	15	<20	438	<0.01	<10	51	<10	<1	34
QC DATA:																														
Repeat:																														
1	1998-3	5	<0.2	2.84	<5	410	10	7.77	<1	29	43	12	4.96	<10	3.74	685	<1	0.04	142	1670	8	10	<20	213	0.19	<10	104	<10	10	52
Resplit:																														
1	1998-3	5	<0.2	2.70	<5	430	10	7.65	<1	27	41	11	4.71	<10	3.61	676	<1	0.03	138	1590	6	15	<20	203	0.15	<10	96	<10	9	50
Standard:																														
GEO'98		135	1.0	1.76	65	155	<5	1.82	<1	19	62	79	4.07	<10	0.98	675	<1	0.02	25	680	20	<5	<20	55	0.11	<10	74	<10	6	73

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28-Aug-98

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V2C 6T4

Phone: 250-573-5700
Fax : 250-573-4557

ICP CERTIFICATE OF ANALYSIS AK 98-474

LLOYD R.NILSEN
6465 CLOVER ROAD
VERNON, BC
V1B 3T7

No. of samples received:12
Sample type: ROCK
PROJECT #: NONE GIVEN
SHIPMENT #: NONE GIVEN
Samples submitted by: L. NILSEN

Values in ppm unless otherwise reported

Et #.	Tag #	Au(ppb)	Ag	Al %	As	Ba	Bi	Ca %	Cd	Co	Cr	Cu	Fe %	La	Mg %	Mn	Mo	Na %	Ni	P	Pb	Sb	Sn	Sr	Ti %	U	V	W	Y	Zn
1	1998-10	145	1.6	1.05	2230	135	10	0.36	<1	40	167	127	9.27	<10	0.54	3137	14	0.02	89	1300	42	<5	<20	73	0.02	<10	56	<10	<1	589
2	1998-11	15	0.4	0.18	1285	<5	10	>10	<1	54	136	21	6.02	<10	>10	1354	4	0.01	573	540	<2	25	<20	3057	<0.01	<10	13	<10	<1	46
3	1998-12	5	0.2	0.35	30	200	<5	0.30	<1	5	217	15	1.61	<10	0.32	298	9	0.01	41	510	4	<5	<20	41	0.01	<10	15	<10	<1	28
4	1998-13	35	0.6	0.21	15	55	<5	0.08	3	7	238	42	1.87	<10	0.09	616	12	0.03	30	90	4	<5	<20	9	<0.01	<10	9	<10	<1	64
5	1998-14	5	<0.2	1.03	10	235	<5	0.63	<1	22	126	90	4.99	<10	0.65	919	8	0.05	33	870	<2	<5	<20	58	0.04	<10	85	<10	3	56
6	1998-15	5	<0.2	3.46	<5	330	15	3.78	<1	22	36	13	5.12	30	0.83	1228	<1	0.21	64	1540	10	<5	<20	292	0.28	<10	113	<10	21	71
7	1998-16	5	<0.2	2.05	15	105	10	1.76	<1	26	93	57	6.35	<10	2.08	1268	4	0.06	40	350	4	5	<20	39	0.05	<10	159	<10	3	53
8	1998-17	45	<0.2	0.80	<5	440	<5	0.32	<1	6	163	41	2.21	<10	0.57	168	3	0.04	15	740	4	<5	<20	24	0.18	<10	60	<10	2	20
9	1998-18	5	<0.2	0.38	25	55	<5	2.19	<1	11	123	39	3.07	<10	0.50	821	4	0.05	25	500	6	<5	<20	91	0.01	<10	25	<10	<1	29
10	1998-19	30	0.2	0.51	10	80	<5	1.18	<1	12	128	62	3.34	<10	0.33	706	8	0.04	14	1110	<2	<5	<20	41	0.03	<10	30	<10	<1	29
11	1998-20	5	<0.2	1.44	10	65	<5	0.20	<1	16	82	113	6.51	<10	0.85	362	4	0.05	16	820	4	<5	<20	21	0.05	<10	120	<10	<1	66
12	1998-21	5	0.4	0.70	<5	40	<5	1.24	<1	16	223	55	3.39	<10	0.88	1030	9	0.01	63	560	2	<5	<20	113	0.01	<10	37	<10	<1	26
QC DATA:																														
Resplit:																														
1	1998-10	160	1.4	1.03	2370	135	<5	0.36	1	43	158	126	9.78	<10	0.54	3345	15	0.03	93	1340	44	<5	<20	80	0.02	<10	56	<10	<1	610
Repeat:																														
1	1998-10	115	1.6	1.05	2310	135	<5	0.36	<1	41	170	128	9.46	<10	0.55	3202	13	0.03	89	1370	44	<5	<20	73	0.02	<10	57	<10	<1	611
Standard:																														
GEO'98		125	1.2	1.82	75	160	<5	1.74	<1	20	64	82	4.20	<10	0.98	734	<1	0.03	22	670	20	<5	<20	63	0.13	<10	80	<10	4	77

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per Frank J. Pezzotti, A.Sc.T.
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IT IS THIS DOCUMENT MADE AVAILABLE AT THE 1987 KEG CONFERENCE THAT INITIATED THE RECO TRIP MAY 28/98.

OPALUS 1 MINERAL CLAIM
OSOYOOS M.D.

INTRODUCTION

The Opalus 1 claim was located to cover the first known precious Opal occurrence found in Canada. The discovery was made in the early 1960s by N. Vernon of Penticton B.C. A specimen weighing 7 pounds was found in a road cut on the north east side of Mt. Laidlaw. This specimen would be worth over $ 130,000.00 today.

LOCATION AND ACCESS

The 20 unit Opalus 1 claim is located in the Osoyoos mining division (NTS) 82E / 5E approximately 15 Km. south west of Penticton B.C. The claims are accessible by road 23 Km. S.W. of Penticton.

GEOLOGY

The claim area is underlain by Tertiary Volcanic rocks of the Marama Formation. Precious Opal was found in massive form in light brown brecciated Rhyolite. The claim hosts several exposures of chocolate brown to black, and pink translucent opal, they occur as breccia fillings and veins in the country rock. The Marama Formation also hosts Epithermal gold deposits. Ie. Dusty Mac, Venner and Vault properties.

CONCLUSIONS AND EXPLORATION PLANS

It is safe to conclude that one, or two exploration targets exist on the Opalus 1 claim.

1 Precious Opal as a valuable gemstone.

2 Epithermal Gold associated with carbonaceous opaline quartz.

Exploration consisting of prospecting, Backhoe trenching, and sampling is planned for 1997.

PARTICIPATION IS WELCOME !

Contact: Craig Lynes Ph. (250) 832 - 2089
Fax. (250) 832 - 9482

E - Mail... mincon@jetstream.net
wwwebsite url... http://cybersongs.com/minconsu/index.htm

Opal Brightness Kit
Instructions for Use

Congratulations!

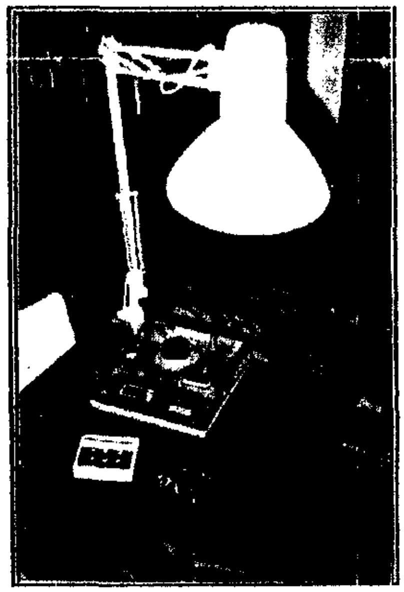
You have just acquired a unique aid to valuing opal, the *Opal Brightness Kit*. Each opal in this kit has been carefully matched to a "Master Set" developed and maintained by Majestic Gems & Carvings, Inc. Your kit is sealed to prevent the movement or switching of opals which would render it useless. To guarantee correct results, use the *Opal Brightness Kit* only in accordance with these instructions. Brightness of fire is only one of many characteristics which influence the value of an opal. This *Opal Brightness Kit* is intended for use in conjunction with the book *Opal Identification and Value*[1] which provides the complete methodology for valuing opal.

Purpose

The purpose of the *Opal Brightness Kit* is to determine the brightness of the fire in any opal as compared to a standard set of opals. Since each *Opal Brightness Kit* is produced by matching the brightness of each stone against a Master Set, the brightness you determine for a particular opal will be identical to that determined by anyone else who has an *Opal Brightness Kit* and uses it in accordance with these instructions.

Illumination

To obtain accurate results with your *Opal Brightness Kit*, the correct lighting is essential. This is provided by an inexpensive desk lamp available from home or office supply stores. The lamp consists of two sets of swing arms with springs and an opaque shade with a rating for 100 watt bulbs. They are available for $10 to $20. See Photograph.



The bulb you employ should be a Sylvania 100 watt Soft White as this is the one used to match your opals to the Master Set. Other frosted 100 watt bulbs are acceptable. Do not use a clear bulb, colored bulb, a reflector bulb, or an energy miser bulb as they each produce different amounts and wavelengths of light from that used to calibrate your *Opal Brightness Kit*.

Surrounding background light should be subdued. It is preferable that it be incandescent rather than fluorescent. Do not grade brightness in direct sunlight or strong background light such as is provided in your showroom.

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[1]For information on *Opal Identification and Value*, contact Majestic Opal, Inc., P. O. Box 1348, Estes Park, CO 80517-1348, (800) 468-0324.

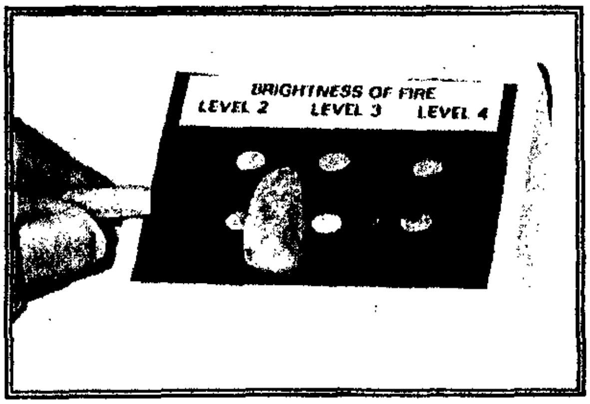
Positioning

The lamp should be positioned so that the shade is 20" above a work surface. The *Opal Brightness Kit* is placed flat upon the work surface with Brightness Level 4 to the right. Move the *Opal Brightness Kit* toward you slightly so that the reflection of the bulb is just off the glass. While measuring the brightness of an opal, look down on the opal and the *Opal Brightness Kit* with your eye parallel or slightly above and fairly close to the lamp shade. This causes you to be looking directly down on the *Opal Brightness Kit* and the opal you are measuring.

Brightness is the amount of light coming back from the opal.

Procedure

To measure the brightness of fire of any opal, place the opal on the glass face of the *Opal Brightness Kit* while the kit is laying flat on the work surface slightly in front of the desk lamp. The label on the *Opal Brightness Kit* must be upright as you would read it with Brightness Level 4 to the right. This matches the orientation of the opals when they were calibrated with the Master Set. Move the opal in various directions to note how its brightness changes. This will give you an overall impression of its brightness as compared to those in the *Opal Brightness Kit*. Compare the brightness of the fire being diffracted from the opal you are measuring against the brightness of the fire in the opals of the *Opal Brightness Kit*. Move the opal you are measuring beside the two opals of each level and compare brightness. Find the closest match.



Remember that you wish to judge the overall brightness of the stone. Frequently there will be a small area that has brighter or duller fire than the rest of the stone. Do not base your judgment of brightness on these small areas. It is the overall impression that is essential.

If the opal is noticeably brighter than Brightness Level 4, grade it as Brightness Level 5. If it is noticeably duller than Brightness Level 2, grade it as Brightness Level 1. It is not uncommon for an opal to fit between two brightness levels. In such cases grade it as the level of brightness that it most closely matches.

Notice that the *Opal Brightness Kit* consists of two opals in each of three brightness levels. Two opals are used because each individual sees color a little differently. With two stones, you can adjust to the difference between your eye and ours more easily. Be sure to keep the glass on the *Opal Brightness Kit* clean and free from finger prints as smudges reduce brightness and can throw off readings.

Directionality

It is important to remember that opals change their brightness depending upon their orientation to the light. This characteristic is termed *directionality*. (See *Opal Identification and Value*, Chapter 9.) After you lay the opal you are measuring on the *Opal Brightness Kit*, move the opal—but not the Kit—in a 360° circle. Note its overall brightness in all different orientations. Next pick up the opal and orient it as it would be worn as a pendant (about 15° off vertical). Again rotate it 360° and note the change in brightness.

There are certain orientations of an opal when used as a pendant or for earrings which are aesthetically pleasing and some which are not. For example, an oval which is set in a pendant would ordinarily have the longest dimension set vertically. Triangular stones would be set with one point up. Note the brightness of the opal in aesthetically pleasing orientations only. Brightness which shows only at an unusual angle not seen when the opal is worn does not enhance the opal's beauty and thus its value.

Some opals orient best as pendants while others want to be rings.

To measure the brightness of a directional opal, select the brightest pendant orientation that is aesthetically pleasing. Compare it to the brightest orientation when the opal is laid flat on the *Opal Brightness Kit*. Use the brightest of these two orientations to measure against the *Opal Brightness Kit*. If using the vertical orientation, place the opal you are measuring next to and just behind the stones in the *Opal Brightness Kit* as the Kit lays flat on the work surface with Brightness Level 4 to the right. Hold the opal on a slightly backward angle as it would be worn in a pendant. Match brightness as you would for an opal laying flat on the *Opal Brightness Kit*.

Away From The Light

As a final check on brightness, observe how the opal you are measuring changes its brightness—and sometimes its fire colors—as you move it away from the grading light. Some stones look fairly bright under the lamp but lose a lot of brightness when removed from the light. Such opals should be graded one brightness level lower if the brightness change is dramatic. Other stones may actually look much brighter under lower light. These opals are true prizes and should be upgraded in brightness one level. I think the reason for this positive change is that these stones diffract light back so much that they look somewhat washed out under the lamp. There is so much light coming to your eye that your eye cannot absorb it all and the opal starts to look like white light. It is similar to an overexposed color picture. Under lower light, your eye can absorb the colors and distinguish them so the stone appears brighter. Such stones are sometimes called *night stones*.

Brightness and Quality

The brightness of an opal is one of four characteristics which determine the price range in which an opal fits. The other three are type, base color, and size. The brightness of fire is the primary determinant of quality within any type and base color. There are many other characteristics which refine this price range into a single estimate of price. These are carefully explained in *Opal Identification and Value*. The relationship between brightness and quality is given in the table below. The quality terms are those used by *The Guide*, an independent source of market prices for opals.[2]

Brightness of Fire		
Level	**Name**	**Quality**
1	Faint	Less than Commercial
2	Dull	Commercial
3	Bright	Good
4	Very Bright	Fine
5	Brilliant	Extra Fine

Only One Factor

Brightness of fire is only one of many factors which determine the quality and value of an opal. The *Opal Brightness Kit* enables you to measure the brightness of any opal against a Master Set. It does not show you how brightness fits in with all other factors to determine value. The *Opal Brightness Kit* is a companion to the book *Opal Identification and Value* which presents a detailed step-by-step methodology for valuing any opal.

Thank you for your interest in opal. If you have any questions, please contact us at:

Majestic Opal, Inc.

P. O. Box 1348

Estes Park, CO 80517

Toll Free (800) 468-0324

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[2]For information on *The Guide*, contact Gemworld International, Inc., 630 Dundee Road, Suite 235, Northbrook, IL 60062, (708) 564-0555.

How Opals Glow Colour

Ok, this is not an earth science, geology, or chemistry lesson, but since many folks wonder what makes opals glow in a rainbow of colours, here's a quick explanation that's hopefully not too technical. Just in case some of the terms are unfamiliar, there's Glossary of Terms following the text.

How Opal Colour is Produced

It took the development of the electron microscope to work this out. Precious opal is made up of *tiny uniform spheres* of transparent hard silica, which fit together in an orderly three dimensional frame, sitting in a "bath" of silica solution. It is the orderliness of the spheres that separates precious opal from common opal.

Light passes through the transparent spheres in a direct line, but when it hits the 'bath' of silica, it is bent and deflected at different angles, thus producing a rainbow effect.

Deflection & Diffraction

Depending on the size of the spheres, varying colours of the spectrum are diffracted. So it is a combination of deflection (bending) and diffraction (breaking up) of light rays that creates the colour in opal. If you move the stone, light hits the spheres from different angles and bring about a change in colour. The name *opal* actually means "to see a change in colour." The way in which colours change within a particular stone as it is rotated and tilted is called the stone's *play of colour*.

How colour is defined.

The size of the spheres has a bearing on the colour produced. Smaller spheres bring out the blues, from one end of the spectrum. Larger spheres produce the reds from the other end. The more uniform the spheres are placed, the more intense, brilliant and defined the colour will be.

BACK NEXT

Glossary of Terms:

Amorphous

Shapeless. Not consisting of crystals. Non crystalline. Glass is amorphous. Sugar is crystalline.

Deflection

The bending of rays of light from a straight line.

Diffraction

The Breaking up of a ray of light into either a series of light and dark bands, or into coloured bands of the spectrum.

Diffuse

To spread out so as to cover a larger space or surface. To *scatter*.

Fluorescent

A *light* produced by the *electrical stimulation of a gas or vapour*. Fluorescent lights have a similar effect on opal as a bright cloudy day--they do not properly bring out the colours in opal

Hydrate

A compound produced when certain substances chemically combine with water.

Incandescent

Glowing with *heat* (*red* or *white* hot) as in a light bulb which glows white hot, but produces a light that more closely simulates natural sunlight. Sunlight and incandescent lights bring out the natural colours in opal.

Opal

Opal comes from the Latin word *opalus* which means to see a change in colour. Chemically, opal is hydrated silica, similar to quartz.

Opalescence

A *play of colour*, similar to that of an opal.

Opaque

Not allowing light to pass through. The opposite of transparent.

Play of Colour

The way in which colours change as an opal is tilted in different directions.

Silica

(Silicon Dioxide) A *hard, white or colourless substance*, that in the form of quartz, enters into the composition of many rocks and is contained in sponges and certain plants. The needle in the mouth of a female mosquito is made of silica. Flint, sand, chalcedony, and opal are examples of silica in different forms.

Spectrum

The band of colours formed when a *beam of white light passes through a prism* or by some other means (e.g. mist or spray, in the case of a rainbow) The full range of spectrum colours are: red, orange, yellow, green blue, indigo, and violet.

Sphere

A round three dimensional geometric shape whose *surface* is equally distant at all points from the centre point.

Translucent

Letting light through without being *transparent*.

Transparent

Easily seen through.(*glass like)*

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KLINKER PRECIOUS OPAL DEPOSIT, SOUTH CENTRAL BRITISH COLUMBIA, CANADA - FIELD OBSERVATIONS AND POTENTIAL DEPOSIT-SCALE CONTROLS

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Robert Yorke-Hardy, Okanagan Opal Inc.

KEYWORDS: Industrial minerals, opal, agate, zeolites, gemstones.

INTRODUCTION

This paper describes the geology and mineralogy of the Klinker opal deposit in south-central British Columbia. The deposit is located within the Tertiary basin that extends 150 km from Okanagan Lake northwest to Kamloops. The area was mapped by Jones (1959) and substantial contributions to the general knowledge of these rocks were made by Church (1979, 1980, 1982), Ewing (1981), Evans (1983), Read (1996a) and Okulitch (1979). It produces both natural precious and common opals. Opal is widespread within the Tertiary basins of British Columbia (Leaming, 1973) and the Klinker deposit is within such a basin. It is located approximately 30 kilometres northwest of Vernon (Figure 1). In 1995 and 1996, the deposit was bulk-sampled using mechanized equipment. Klinker is the first precious opal deposit under development in Canada. Although it is hosted by a volcanic sequence, it may have some similarities with sediment-hosted deposits because of a possible association with an unconformity and intense weathering. Opal extracted from the Klinker deposit typically does not have a tendency to crack or craze when exposed to the atmosphere and is referred to as "stable". It has excellent brightness and multicolour "flash" to "broad flash" patterns. It may be water-clear, orange, honey, red-brown, orange or white in colour. Clarity of the stones varies from transparent through translucent to opaque. At present, doublets, triplets, solid and boulder opal are produced from the bulk sample extracted from the Klinker deposit and are being test-marketed within the Vernon area of British Columbia

Figure 1. Location of the Klinker precious opal deposit, British Columbia.

Opal is an amorphous form of silica ($SiO_2 \cdot nH_2O$) containing typically 3 to 10 percent water, although some opals contain as much as 20 percent water. X-ray analyses of many opals give weak patterns of cristobalite or tridymite. Common opal may occur mixed or alternate with agate, forming stripes or bands. Precious opal is defined as opal with a "play of colour", caused by diffraction of white light by regular packing of silica microspheres within the mineral structure (Darragh *et al.*, 1976). Common opal has a less ordered packing of silica microspheres within the mineral structure and has no "play of colour". The term "common opal" groups all opals without play of color. The term "fire opal" describes a common opal having a transparent orange to red-orange base color (Downing, 1992). Therefore, precious opal is not a synonym for "fire opal".

Worldwide, precious opal is rare in comparison to common opal. There is a relatively good market for precious opal. Australia produces approximately $CDN 44 million worth of precious opal and the prices of most commercial opal exceed $CDN 40 per gram of rough material. The best grades are valued at more than $CDN 1400 per gram. Good to excellent quality, stable common opal, used as faceting material, such as the orange, transparent variety (also called "fire opal"), ranges in value from $CDN 5 to 300 per gram depending on color. The cherry-red variety is the most expensive. The market for facet-grade opal is smaller than that of precious opal.

Deposits that contain precious opal can be divided into two major categories based on host lithologies: sediment-hosted and volcanic-hosted. Australian deposits of the Coober Pedy, Andamooka and Mintabie areas are excellent examples of sediment-hosted deposits. Deposits such as Spencer (Idaho, USA), Tevern (New South Wales, Australia), La Carbonera and Iris mines (Mexico) and the deposits in the Gracios à Dios area (Honduras) are excellent examples of the volcanic-hosted category. The source of silica for sedimentary-hosted deposits is

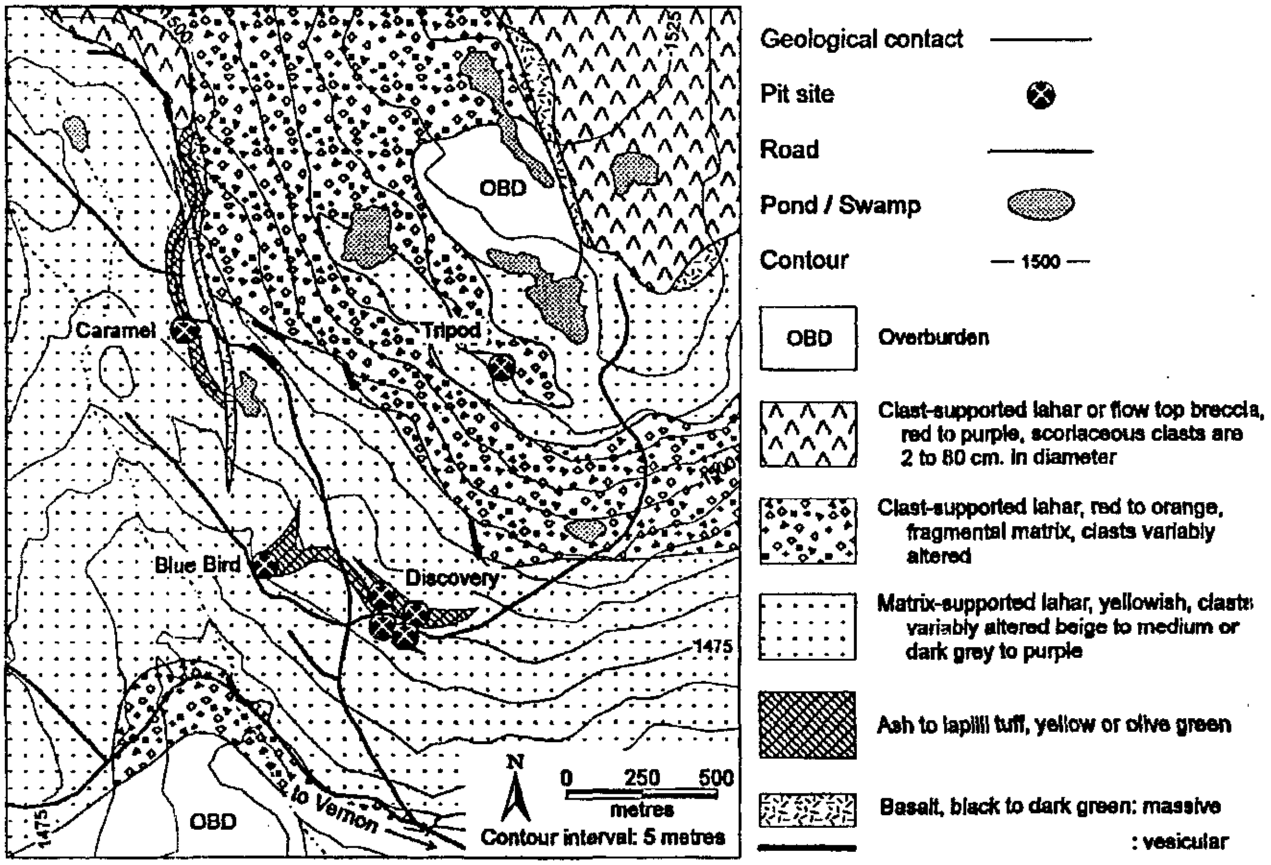

Figure 2. Geology of the Klinker deposit area.

linked to deep and intense weathering while, in general, volcanic-hosted deposits are believed to be genetically associated with hydrothermal activity.

GEOLOGY OF THE KLINKER DEPOSIT

The opal occurrences at the Klinker property are well exposed in an area of clear-cut logging. Most of the exposed rock, with the exception of mafic dikes and the massive portions of lava flows, is strongly hydrothermally altered or weathered. The depth of alteration or weathering is expected to vary substantially, but may be several metres deep as indicated by the presence of fresh rock exposed in the Discovery level 1477 open cut. The Klinker deposit is hosted by clast and matrix-supported lahars and ash to lapilli tuff units of the Eocene Kamloops Group that were initially assigned to the Dewdrop Flats Formation (Read, 1996a) but later interpreted as the Tranquille Formation (Read, 1996b). In the type localities, near Kamloops, the Dewdrop Flats Formation comprises a section of more than 1000 metres thick with nine members. The dominant lithologies are palagonitic basalt and andesite lava flows, flow top breccias, mudflows and dacitic ash flows. aphiric basalt, andesite and dacite flows and tephras (Ewing, 1981a; 1981b and 1982). Radiometric dates reported from Dewdrop Formation vary from 48.6 to 50.5 million years (Ewing, 1981b; Church and Evans, 1983). Typically, the Tranquille Formation underlies the Dewdrop Flats Formation. It comprises andesitic and basaltic tuffs, tuffaceous sediments, palagonite breccia, mudflows, lithic wackes and grey-black shale (Ewing, 1981a and 1982).

Samples of bedded, unconsolidated sediments found in topographic lows overlying the opal-bearing lahars at the Klinker deposit contain Middle Miocene palynomorph assemblages (conifer pollen, angiosperm pollen, fungal spores and cysts) that are similar to assemblages in the Fraser Bend Formation, near Quesnel (Rouse and Mathews, 1979). The samples are assigned to the Barstovian mammalian stage of the Western North American Tertiary, *circa* 13-17 Ma. These palynomorphs, derived from surrounding shore-line habitats, indicate shallow stream or lake edge sediments. Another sample of partly consolidated, bedded tuffaceous sediments containing broad leaf fossils, collected a few kilometres away contains palynomorphs of the same age. A sample of lithified yellow to olive green, ash to lapilli tuff (Figure 2) within the opal-bearing lahars yielded small quantities of conifer palynomorphs that are probably of similar age.

If the Middle Miocene age of the tuff containing opal is confirmed, then the precious opal-hosting rocks are substantially younger than previously thought. On the other hand, if the opal-bearing tuff and lahars belong to the Dew Drop Flats Formation, as suggested by Read (1996a), then an important unconformity could be expected between the opal-bearing sequence and overlying, partly consolidated tuffaceous sediments of mid-Miocene age.

Opal Occurrences

Rock types can be divided into five major lithologies, including matrix and clast-supported lahars, scoriaceous *lahar or flow top breccia, ash to lapilli tuff and lava flows* or dikes and sills. The lahar units may be relatively thin and possibly repeated, by block sliding, as they dip shallowly (0 to 20°) and closely follow topography (Figure 2). Due to the undulating surfaces of the successive lahars, the strike directions are highly variable over short distances. No drilling has been done on the property and so it is not yet possible to establish the total thickness of overlapping lahar flows and depth to underlying massive and brecciated, unmineralized volcanic rocks that outcrop 500 metres east of the mapped area. Also, it is unknown to which depth precious opal can be found.

Lahars and debris flows are the most abundant of the five major rock types exposed at the Klinker deposit. In general, the lahars are inhomogenous, poorly sorted, unstratified and are nearly tabular on the large scale but have irregular contacts at the outcrop scale. In some lahar layers, the clasts are well sorted. Some flows have as little as 5 percent interstitial material.

Fine-grained, yellow or olive green, ash to lapilli tuff is typically 20 centimetres to 3 metres thick. It is characterized by centimetre-scale bedding, some cross bedding, reverse and normal grading and may form a series of lenses rather than a continuous layer. It appears that this rock forms a single marker unit, however it is possible, due to limited exposure down section, that there may be more than one layer. Near surface, this rock is characterized by loose, yellow, sandy debris and where fresh surfaces are available the rock is olive green. Locally, the bottom contact of this unit is highly irregular. Individual clasts are less than four millimetres in size and typically less than 0.5 to 2 millimetres in size. Precious opal is commonly found within this unit and in matrix-supported lahar immediately above or below it.

Matrix-supported lahar is characterised by a yellow matrix which makes up 10 to 25 percent of the rock. The composition of the sandy matrix is identical to that of the ash to lapilli tuff. Clasts are subrounded to subangular, 2 centimetres to 1 metre in diameter and typically 5 to 10 centimetres across. Clasts consist mainly of massive or vesicular basalt and scoria in various proportions. The colour of the clasts varies from beige to medium or dark grey to purple.

Clast or coarse matrix-supported lahar is more altered or weathered than the previous unit and has a red to orange matrix. The matrix is light red-brown or salmon pink in zones where white zeolite is abundant. Typically, the matrix forms less than 10 percent of the rock. In some instances, small clasts (<3 cm) form the matrix between coarse fragments that are 5 centimetres to 1 metre in diameter. In some areas, chabazite and other zeolites (probably heulandite and stilbite), completely fill vesicles and fractures and locally, zeolites are a major component of the matrix. This unit only contains agate or common or precious opal where zeolites are absent.

Scoriaceous, strongly oxidized, red to purplish, clast-supported lahar or flow top breccia outcrops in the northeast corner of the study area (Figure 2). Due to the flat, rubbly nature of the outcrops, low relief and similarity of clasts, it is not possible to determine if this unit is a lahar or flow top breccia. Over 80 percent of the clasts are scoriaceous, typically ½ to 3 centimetres in diameter and red in colour. However, pumice fragments may be as much as 60 centimetres in diameter. Twenty to eighty percent of the rock is void space and is not known to contain opal or the zeolites chabzite, heulandite or clinoptilolite. However, loose pieces of agate were found on several outcrops.

Basalt is dark green to black on fresh surfaces and medium green or beige-brown on altered surfaces. It is mostly massive but, in some places, moderately vesicular and more altered near the tops of flows or sills. Mafic phenocrysts are typically less than 3 millimetres in size and form less then 8 percent of the rock. Outcrops of the massive variety are characterized by flat polished surfaces, except where it coincides with breaks in slope and then is blocky to angular. Because of the flat nature of basalt outcrops, it is often difficult to determine if it forms sills, dikes or flows. This unit normally does not contain any opal. However, in one outcrop near the Caramel pit, a mafic dike contains rare, opal fracture fillings. This shows that some dikes post-date lahar flows and predate opal mineralization. In some areas, stretched vesicles are filled by radiating zeolite crystals that may be thompsonite.

Cross Sections

Sections of the Caramel and Blue Bird pits are illustrated on Figures 3 and 4 respectively and located on Figure 2. They show the detailed geology in the pits and illustrate the subhorizontal to shallow dipping aspect of the lahar units. They also illustrate the relationship between individual lahar flows and the enclosed ash to lapilli tuff. In the Caramel pit, the oldest unit appears to be coarse, matrix supported, opal-bearing lahar, with a very irregular upper contact. This is overlain by centimetre-scale, bedded tuff, which is, in turn, overlain by another coarse, matrix-supported, opal-bearing lahar. Above that is a dark green to black lava flow, massive near its base and very vesicular near its top. The vesicles are elongate and filled with common opal or agate. This flow is overlain by a yellow, matrix supported lahar. In the Bluebird pit, reworked ash to lapilli tuff is discontinuous and appears to have been eroded by the overlying lahar flow. The mud seams in the pit face (Figure 4) consist of very fine-grained layers of soft material, probably a mix of clay and feldspar, ½ to 5 centimetres thick. In the Bluebird and Caramel pits, opal is found immediately above, below and within the ash to lapilli tuff. It is important to note that the ash to lapilli tuff occurs in all precious opal bearing pits.

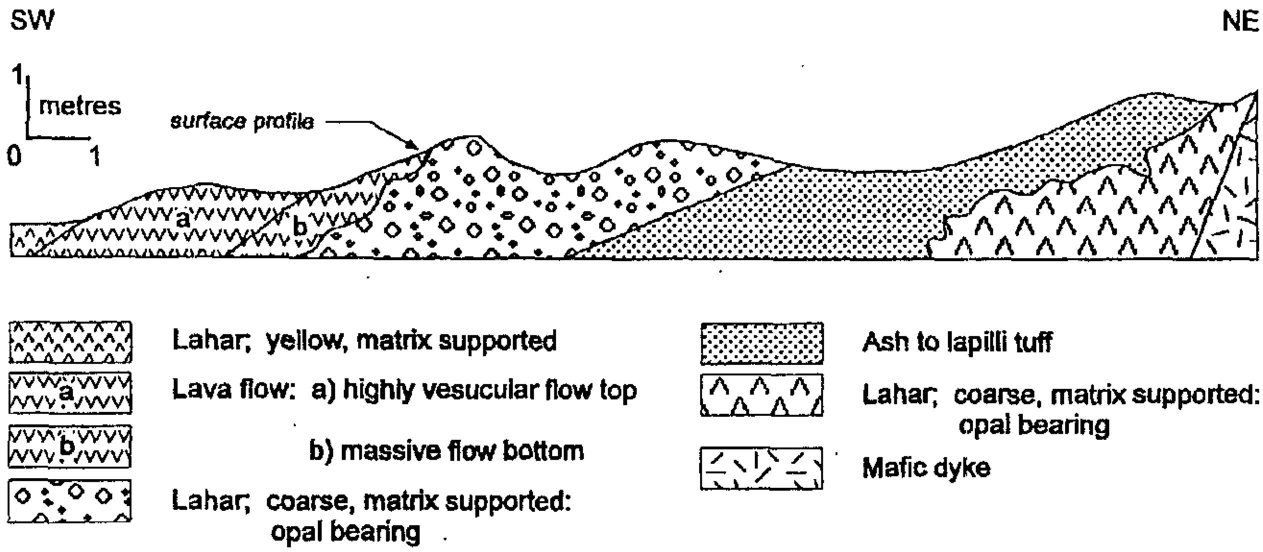

Figure 3. Cross section of the Caramel Pit, looking northwest. For location see Figure 2.

MINERALIZATION

Precious opal occurs as open space fillings, mainly within fractures, voids and vesicles. Other fracture fill minerals at the Klinker deposit are agate, non-precious facet-grade opal, common opal, quartz, celadonite, amorphous manganese oxides, clinoptilolite, heulandite, stilbite, clays and rarely, calcite. Non-precious, facet-grade opal is typically orange and honey coloured, similar to Mexican "fire opal". Common opals occur as transparent, translucent and opaque types in white, honey, brown, amber, orange and grey colours. Quartz can occur as small, inward facing, terminated crystals within vugs. X-ray diffraction analysis reported by Awram (1996) notes that kutnahorite and saponite co-exist with opal. Opal from the Klinker property is classified as opal-CT, using Jones and Segnit's (1971) grade classification (Awram, 1996). Most stones from deposits with precious and common opal are classified as opal-A (Frye, 1981). Detailed studies of opal microstructure are underway to confirm and refine Awram's findings.

CONTROLS ON OPAL DISTRIBUTION

Mineralogical Zoning

The first and most readily apparent control on opal distribution is stratigraphy and rock porosity. As previously mentioned, opal occurs within ash to lapilli tuff and immediately adjacent matrix-supported lahar. However, at the scale of the property there are also mineralogical controls. Opal and agate have a complex relationship with zeolites. They do not exist in zeolite-rich zones that contain chabazite, the most abundant, heulandide, clinoptilolite and stilbite. These are the most significant vesicle and fracture fillings and matrix

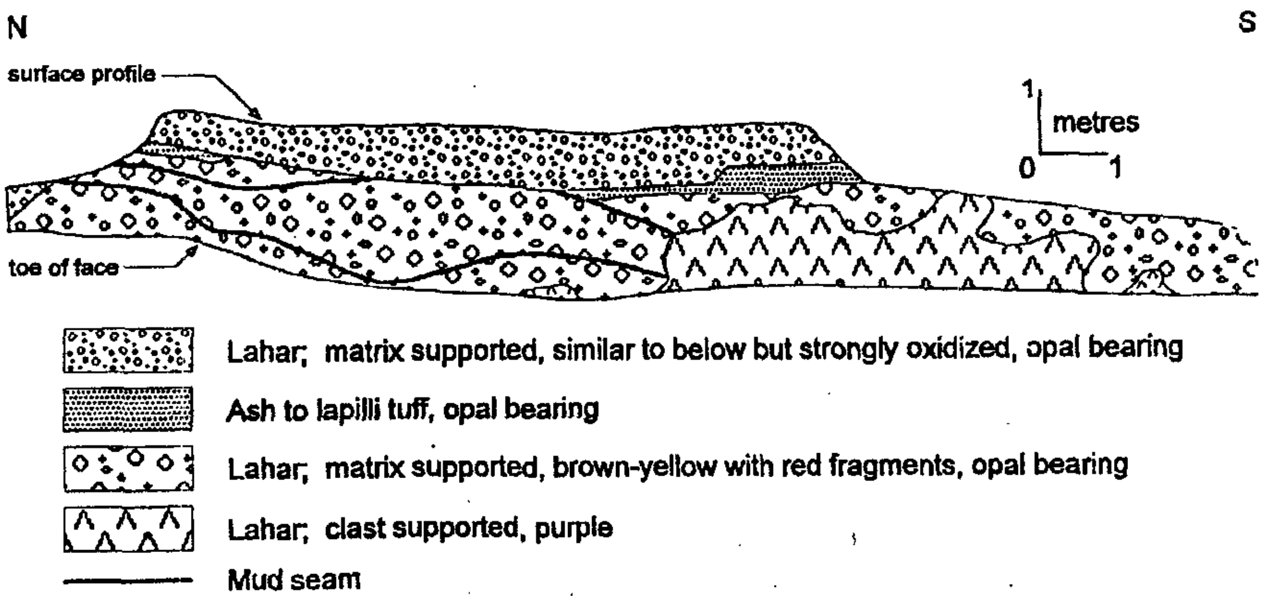

Figure 4. Cross section of the Blue Bird Pit, looking southeast. For location see Figure 2.

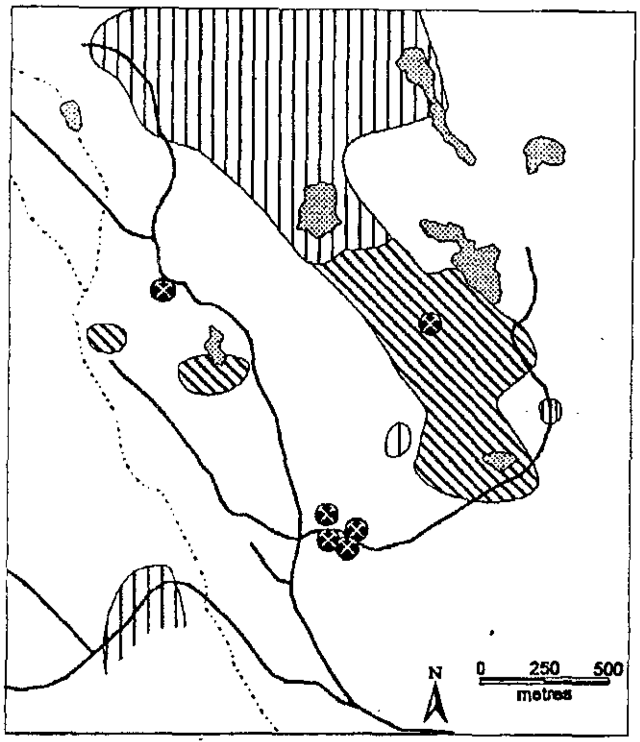

Figure 5. White zeolite-bearing zone (vertical lines) and yellow-sugar coating zone (angle lines); Klinker area.

cement in the north central part of the map area (Figure 5). Opal and agate occur where the zeolite-rich fillings give way to a yellow, sugary coating in fractures and vesicles, towards the southeast (Figure 5). X-ray diffraction patterns of this yellow coating yield weak peaks for tridymite with minor clinoptilolite(?). This coincides broadly with the change of red, strongly oxidized coarse matrix-supported lahar to yellow, fine-grained matrix-supported lahar. The yellow, sugary *coating coexists with agate and possibly opal in the east* central part of the map area. The only exception to the mutually exclusive relationship of white zeolites and silica is in the Caramel extension zone. There the subhorizontal, undulating contact between two distinct lahar flows parallels the current erosional surface. It may be that one flow contains agate, common and precious opal, *while the other flow contains white zeolite-filled* vesicles.

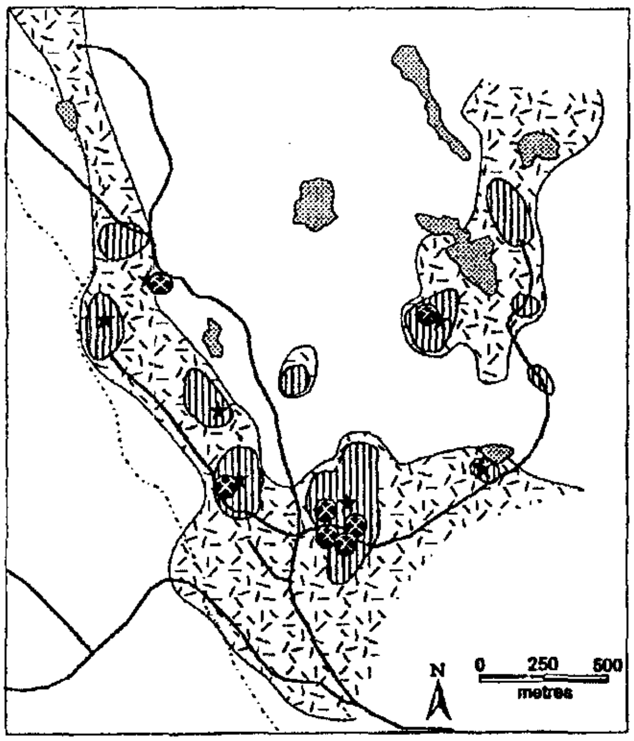

Figure 6. Distribution of agate (random lines), common opal (vertical lines) and non-precious facet-grade opal and precious opal (stars); Klinker deposit area.

Another major mineralogical control is that opal occurs only within broad areas of agate mineralization and precious opal only in small areas within common opal mineralization (Figure 6). Agate has the widest distribution, forming a northwest trending belt. White, opaque common opal, brown or honey opal, transparent opal and precious opal occupy successively smaller, more restricted areas. Precious opal is known to occur at only a few locations (Figure 6). A similar range in mineralogy exists in individual fractures. Some are filled only by agate, by agate and common opal, by common opal and transparent common opal and finally by non precious orange, honey or yellow facet-grade transparent opal and precious opal. In general, agate and precious opal do not coexist in a given fracture without the presence of one or *both of common opal and common transparent facet-grade opal.*

Structural Controls

Most of the precious opal on the property occurs as vesicle and fracture fillings. Consequently, the distribution and orientation of fractures is important. The orientation of the fractures is summarized on comparative stereographic plots (Figure 7). Most data comes from the Discovery, Blue Bird, Caramel and Caramel Extension pits because intense weathering makes acquisition of structural data elsewhere difficult. Figure 7a indicates most of the fractures in the Klinker area are steeply dipping to subvertical and strike 170°, regardless of fracture fillings. Figure 7b indicates that the same pattern holds for fractures filled by silica minerals, agate, common and precious opals; there are two other less pronounced orientations at 073° and 035°. Figure 7c shows similar orientations for precious and transparent *common opal filled fractures with another subset at 060°*, based on very limited data. In summary, there is no obvious statistical correlation between fracture orientations and mineral fillings. The main fracture set is roughly 170°, but minor subsets may be important. The 170° preferred orientation coincides the major lineaments that may have acted as solution channels and extend beyond the property boundaries. These lineaments were detected by air-photo interpretation by R. Yorke-Hardy and confirmed by Penner and Mollard (1996). Both the mineralogical and structural findings can be used as exploration guides on the property, but it is not known if it can be applied beyond there.

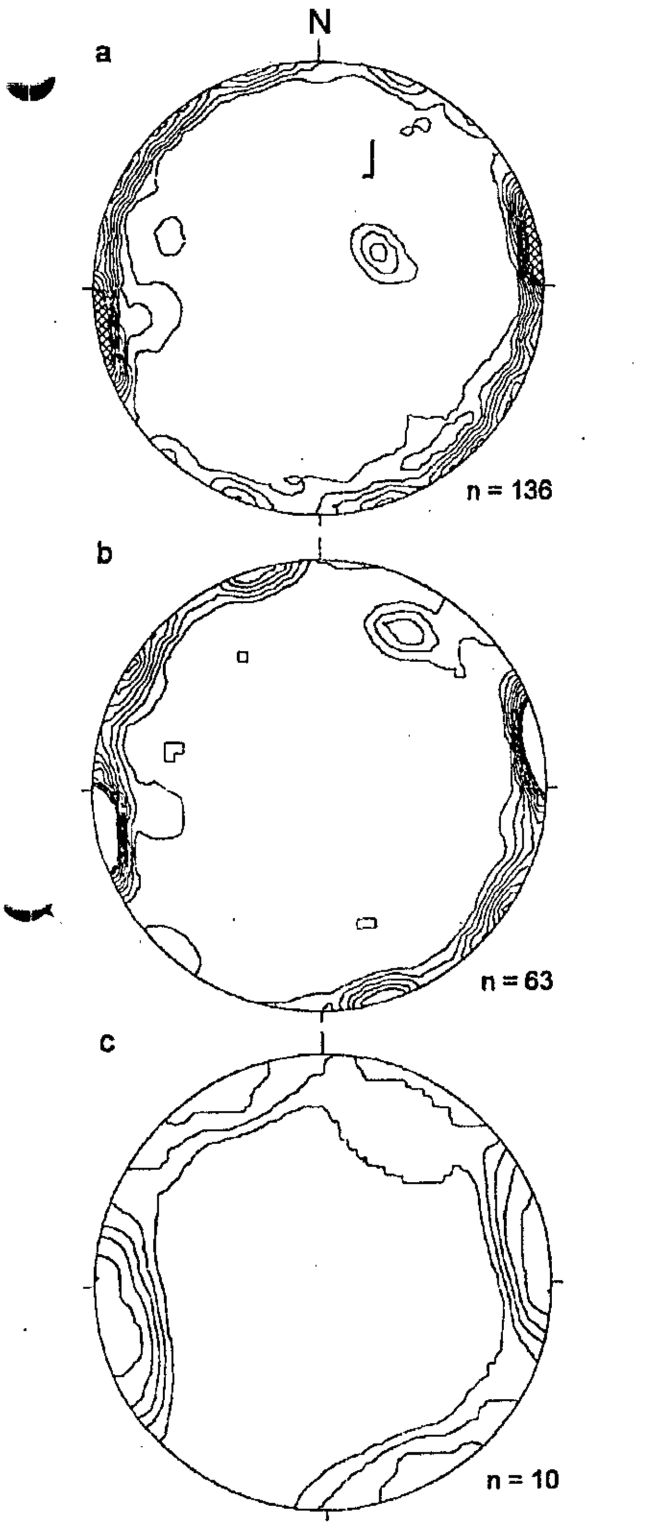

Figure 7. Preferred orientations of poles to fracture planes sorted by fracture fillings: a) all fractures; b) fractures with silica filling only; c) fractures filled by facet-grade and precious opal. Lower hemisphere plot. n = number of poles. Contours are 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 times unity. Cross-hatching in eas greater than 10 times unity. Comparative plots made ing the method of Starkey (1970, 1977, 1993).

SUMMARY

The most significant findings of our fieldwork are the mineralogical guides to the potential distribution of precious opal at the property. Precious opal mineralization occurs within ash to lapilli tuff and adjacent lahar units and is surrounded by larger zones that contain agate and common opal. Opal mineralization does not occur within lahar that contains white zeolite fracture and vesicle fillings or matrix cement. There is no preferred strucutral control to opal mineralization. Rock types are divided into five major lithologies, including matrix and clast-supported lahars, scoriaceous lahar or flow top breccia, ash to lapilli tuff and lava flows or dikes and sills. We have established that ash to lapilli tuff overlying the opal-bearing lahar sequence is of mid-Miocene age and is substantially younger than previously believed. Opal-bearing lahars are probably of the same age, but if they belong to the Dewdrop Flats Formation, as postulated by Read (1996a), one would expect a major unconformity between the opal-bearing sediments and overlying mid-Miocene, partly consolidated tuffaceous sediments.

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