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Electron-microprobe analyses of chromite and olivine from alpine ultramafic complexes

TN4

By

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This report is preliminary and has not been edited or reviewed for conformity with U. S. Geological Survey standards and nonmenclature

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Contents

U. S. GOVERNMENT PRINTING OFFICE : 1972 O - 457-084

Tables

Table 1. Electron-microprobe analyses of chromite from alpine ultramafic complexes

Table 2. Electron-microprobe analyses of olivine from alpine ultramafic complexes. The number of the olivine analyses given in parenthesis associated corresponds to the number of the chromite analysis in Table 1.

U. S. GOVERNMENT PRINTING OFFICE : 1972 O - 457-084
867-100

Illustrations

Figure 1. Topographic map of Canyon Mountain, Oregon, and vicinity showing the distribution of the chromite sample collection. The number at each site corresponds to the analysis number in Table 1.

2. Map showing the principal chromite deposits of the Twin Sister's Mountains, Washington and the chromite sampling sites. The number (71-87) at each sample site corresponds to the numbers in Table 1.

3. Index map of the Camaguey district, Cuba, showing the distribution of chrome deposits and principal producing mines. The circled numbers indicate the mines sample used in this report. The number correspond to the analyses of Table 1.

4. Geologic-Topographic map of Red Mountain, Alaska showing the distribution of samples (181-247) analyzed in this study.

U. S. GOVERNMENT PRINTING OFFICE : 1972 O - 457-084

Electron-microprobe analyses of chromite and olivine from alpine ultramafic complexes

by

M.L. Bird

Introduction

This report contains electron-microprobe analyses of the minerals chromite (Table 1), and olivine (Table 2), from many alpine-type complexes having a world-wide distribution.

Many of the samples in this study were collected from various deposits, mines, and associated ore piles during the last 35 years by T.P. Thayer and each is representative of an individual occurrence. The orientation or location of these samples within individual mines or deposits, however, is unknown.

Samples from ultramafic complexes in Alaska were collected by P.W. Guild, A.L. Clark, and Don Grybeck. The collection localities of most of the Alaskan samples are accurately known and many were collected on traverses which were oriented with regard to the lithology.

The chromitite samples from the Coolac complex in Australia were obtained from H.G. Golding.

Each analysis presented in the tables represents a single point on a mineral grain and is <u>not</u> an average of several analyses. Wherever a large variation occurs within a specimen several analyses may be given to illustrate the variations. Where only one analysis is given for a sample it represents an unaltered central part of a mineral grain and no significant variations are apparent. Where analyses are

U. S. GOVERNMENT PRINTING OFFICE: 1972 O - 457-084
887-100

presented for both chromite and olivine in the same specimen they are from adjacent mineral grains in the sample. The analyses for the different minerals are presented in separate tables. The chromite analyses (Table 1) are numbered consecutively and the corresponding olivine analysis (Table 2) is indicated by the number of the chromite analysis shown in parenthesis.

On many specimens microprobe traverses were made across mineral grains and across boundaries between grains. All of these data are not included in this report but are the subject of other reports now in preparation.

The ratios $Cr/(Cr+Al+Fe^{3+})$, $Mg/(Mg+Fe)$, and Cr/Fe are given immediately below the chromite analyses in table 1. Also given is the mean precentage of Cr_2O_3 in the high-chromium (Cr_2O_3 44.5%) and low-chromium (Cr_2O_3 44.5%) chromites. The mean and variance are calculated every ten analyses (each page). Average Cr_2O_3 contents and standard deviation for high-alumina and high-chromium chromites is also given for each ultramafic complex.

U. S. GOVERNMENT PRINTING OFFICE : 1972 O - 457-084
867-100

Electron-Microprobe analysis

The electron-microprobe analyses were made using an ARL-EMX-SM microprobe having three spectrometers equipped with LiF, ADP, and RAP crystals. Microprobe parameters included a beam current of approximately 0.1 μa, an accelerating voltage of 15KV, and a beam diameter of approximately 1 μm. The beam current was integrated over 2.000 μa to give a counting time of approximately 20 seconds.

Analysis for each of the elements Ca, Cr, Al, Si, Fe, Mg, Ti, Ni, and Na was made at several points on each mineral grain by setting the spectrometers on three elements at a time in the order given above. In the analysis of a few samples Mn, V, and/or Zn were substituted for Ni and Na. X-ray count data were first taken on a standard then on the unknown minerals. Data were taken on several unknown mineral grains and then again on the standard without changing the spectrometers or microprobe parameters. Duplicate readings were made on each point analyzed. After all points of interest were analyzed for a set of three elements the spectrometers were reset for the next three elements, each point was re-occuppied by the electron beam, and the data collection procedure was repeated.

After collecting X-ray counts for all of the elements the data for each point were reduced to weight percentages using the procedures of Sweatman and Long (1969).

The weight percentages of FeO and Fe_2O_3 in chromite were determined from total iron (as FeO) by adding sufficient FeO to the other dispositive ions to make 1.000 mole and recalculating the remaining iron as Fe_2O_3. Total iron in olivine is reported as FeO. The number of moles of Ti^{4+} are doubled and added to the dipositive ions in the calculation of FeO and Fe_2O_3.

Standards

The standards used for microprobe analysis included a chemically analyzed chromite from Union Bay, Alaska for Cr, Fe, Ni, and Ti. The standard for Mg and Si were synthetic enstatite and forsterite; the Ca and Al standard was synthetic anorthite and for Na, synthetic diopside-jadeite (Di_{65}-Id_{35}).

Other chromite standards from the Stillwater complex were usually run as unknowns to check against errors.

Sample preparation

Standard polished rock specimens mounted in bakelite or polished thin sections were prepared for each of the samples. The final step of polishing was made with 1 μm diamond paste or alumina powder where satisfactory results were obtained. The rock sections were then studied under the microscope and areas to be analyzed with the electron microprobe were marked with paper pointers. Photographs were frequently made to facilitate re-occupation of probed points with the electron beam.

Each section was then covered with a thin coat of carbon in a vacuum evaporator to enchance its conductivity of the electron beam.

U. S. GOVERNMENT PRINTING OFFICE : 1972 O - 457-084
867-100

Collection localities and descriptions of samples

The names and locations of the mines or ultramafic complexes from which each sample was collected, the name of the collector, and UTM coordinates, where available, are given in an appendix following the analyses. Other data regarding the sample including information concerning alteration, whether the chromite is massive or accessory and the associated silicate minerals are also given in the appendix. Maps showing the location of many of the sample collection sites are shown in figures 1-4.

Figure 1 is a map of the Canyon Mountain, Oregon area showing the distribution of the samples sites of the first 67 samples and figure 2 shows the main chromite deposits and samples sites of the Twin Sister's Mountain analyses (70-87).

Locations of the Red Mountain, Alaska samples (181-247), except the R-G series, are shown on the map of Red Mountain (fig. 4). Similarly the Cuban deposits in the Camaguey district are located on the map of figure 3. Samples from other localities are not shown on maps.

U. S. GOVERNMENT PRINTING OFFICE : 1972 O - 457-084

References

Sweatman, T.R., and Long, J.V.P., 1969, Quantitative electron probe microanalysis of rock forming minerals. J. Pet. 10, 332-379.

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Table 1

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867-100

MICROPROBE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	1	2	3	4	5	6	7	8	9	10
CR2O3	54.25	44.78	38.39	45.65	53.24	53.85	54.45	47.51	48.18	63.19
AL2O3	12.54	19.38	30.02	24.43	16.87	16.98	14.77	20.40	19.95	8.23
FE2O3	3.12	5.53	2.35	2.82	1.29	0.51	2.64	4.51	1.87	0.42
V2O3	******	******	******	******	******	******	******	******	0.14	******
SIO2	0.06	0.12	0.08	0.08	0.04	0.04	0.17	0.12	0.06	0.10
TIO2	******	******	0.20	0.41	0.18	0.18	0.11	0.10	0.06	0.15
NIO	******	******	0.12	0.20	0.15	0.13	0.12	0.21	******	0.08
CAO	0.02	0.02	0.0	0.01	0.06	0.09	0.02	0.02	0.0	0.0
ZNO	******	******	0.01	0.0	0.04	0.01	0.01	0.02	******	0.03
FEO	20.30	21.66	15.23	14.67	14.45	15.03	14.04	12.75	16.37	16.74
MGO	8.75	8.82	13.86	13.74	12.68	12.38	12.93	14.45	11.95	10.56
TOTAL	99.04	100.31	100.26	102.01	99.00	99.19	99.26	100.09	98.58	99.50

NUMBER CATIONS / 4 OXYGENS

CR	1.427	1.131	0.898	1.075	1.336	1.351	1.374	1.153	1.205	1.662
AL	0.492	0.730	1.046	0.858	0.631	0.635	0.556	0.738	0.744	0.323
FE3	0.078	0.133	0.052	0.063	0.031	0.012	0.063	0.104	0.045	0.011
V	******	******	******	******	******	******	******	******	0.004	******
SI	0.002	0.004	0.003	0.003	0.001	0.001	0.005	0.004	0.002	0.004
TI	******	******	0.004	0.009	0.004	0.004	0.003	0.002	0.002	0.004
NI	******	******	0.003	0.005	0.004	0.004	0.003	0.005	******	0.002
CA	0.001	0.001	0.0	0.000	0.002	0.003	0.001	0.001	0.0	0.0
ZN	******	******	0.000	0.0	0.001	0.000	0.000	0.001	******	0.001
FE2	0.565	0.579	0.377	0.366	0.384	0.399	0.375	0.327	0.433	0.466
MG	0.434	0.420	0.611	0.610	0.600	0.586	0.615	0.661	0.564	0.524

MOLAR RATIOS

CR/(CR+AL+FE3)	0.715	0.567	0.450	0.539	0.669	0.676	0.689	0.578	0.604	0.833
MG/(MG+FE2)	0.435	0.421	0.619	0.625	0.610	0.595	0.621	0.669	0.565	0.529
CR/FE	2.2	1.6	2.1	2.5	3.2	3.3	3.1	2.7	2.5	3.5

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 51.68 SD: 5.78

HIGH AL MEAN: 38.39 SD: 0.0

****** NOT ANALYZED

MICROPROBE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	11	12	13	14	15	16	17	18	19	20
CR2O3	53.04	53.46	50.12	52.73	51.91	36.88	31.58	57.00	62.55	56.94
AL2O3	17.70	17.47	21.04	17.02	18.66	30.82	33.80	13.14	7.86	14.66
FE2O3	1.65	0.0	1.23	1.60	1.03	3.14	6.21	0.62	0.20	1.18
SIO2	0.04	0.04	0.0	0.02	0.0	0.05	0.0	0.11	0.05	0.0
TIO2	0.25	******	******	0.15	******	******	0.61	******	******	0.11
NIO	0.15	******	******	0.06	******	******	0.25	******	******	0.20
NA2O	******	******	******	0.0	******	******	******	******	******	******
CAO	0.0	0.01	0.08	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ZNO	0.0	******	******	******	******	******	0.06	******	0.03	0.01
FEO	13.64	15.42	14.34	13.98	14.31	14.76	16.22	14.50	12.94	14.93
MGO	13.51	12.35	13.81	13.09	13.38	14.50	13.41	12.37	12.48	12.58
TOTAL	99.98	98.75	100.62	98.65	99.29	100.15	102.14	97.74	96.11	100.61

NUMBER CATIONS / 4 OXYGENS

CR	1.308	1.345	1.212	1.324	1.286	0.858	0.719	1.473	1.678	1.425
AL	0.651	0.655	0.759	0.637	0.689	1.069	1.147	0.507	0.315	0.547
FE3	0.039	0.0	0.028	0.038	0.024	0.070	0.135	0.015	0.005	0.028
SI	0.001	0.001	0.000	0.001	0.0	0.002	0.0	0.004	0.002	0.0
TI	0.006	******	******	0.004	******	******	0.013	******	******	0.003
NI	0.004	******	******	0.002	******	******	0.006	******	******	0.005
NA	******	******	******	0.0	******	******	******	******	******	******
CA	0.0	0.001	0.003	0.0	0.0	0.0	0.0	0.000	0.000	0.0
ZN	0.0	******	******	******	******	******	0.001	******	0.001	0.000
FE2	0.356	0.410	0.357	0.371	0.375	0.363	0.391	0.397	0.367	0.395
MG	0.628	0.586	0.630	0.620	0.625	0.637	0.575	0.603	0.631	0.594

MOLAR RATIOS

CR/(CR+AL+FE3)	0.655	0.672	0.606	0.662	0.643	0.430	0.359	0.738	0.840	0.712
MG/(MG+FE2)	0.638	0.588	0.632	0.625	0.625	0.637	0.596	0.603	0.632	0.600
CR/FE	3.3	3.3	3.1	3.2	3.2	2.0	1.4	3.6	4.5	3.4

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 53.11 SD: 5.10

HIGH AL MEAN: 35.62 SD: 3.58

****** NOT ANALYZED

MICROPROBE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	21	22	23	24	25	26	27	28	29	30
CR2O3	55.86	35.28	35.23	30.47	41.50	36.89	35.69	35.85	49.70	34.75
AL2O3	12.84	35.37	33.14	36.84	26.69	31.87	33.59	31.37	19.72	36.31
FE2O3	2.46	1.93	2.36	2.71	2.65	1.07	2.52	3.49	1.58	0.98
SIO2	0.08	0.0	0.19	0.12	0.06	0.19	0.08	0.10	0.06	0.04
TIO2	0.16	0.15	0.15	0.18	0.20	******	******	******	0.20	******
NIO	0.11	0.21	0.07	0.11	0.08	******	******	******	******	******
NA2O	******	******	******	******	******	******	******	******	0.0	******
CAO	0.02	0.0	0.20	0.0	0.11	0.15	0.07	0.07	0.04	0.0
MNO	******	******	******	******	******	******	******	******	0.23	******
ZNO	0.0	0.02	0.0	0.0	0.01	******	******	******	******	******
FEO	15.06	13.51	15.02	13.67	15.34	15.12	16.61	19.01	18.60	13.63
MGO	12.12	15.96	14.35	15.47	13.31	14.14	14.04	12.11	10.61	16.19
TOTAL	99.71	102.43	100.71	99.57	99.95	99.43	102.60	102.00	100.74	101.90

NUMBER CATIONS / 4 OXYGENS

CR	1.449	0.785	0.808	0.691	0.989	0.860	0.808	0.833	1.231	0.773
AL	0.488	1.174	1.133	1.246	0.948	1.108	1.134	1.086	0.728	1.204
FE3	0.060	0.041	0.052	0.059	0.060	0.024	0.054	0.077	0.037	0.021
SI	0.003	0.0	0.006	0.004	0.002	0.005	0.003	0.003	0.002	0.001
TI	0.004	0.003	0.003	0.004	0.005	******	******	******	0.005	******
NI	0.003	0.005	0.002	0.003	0.002	******	******	******	******	******
NA	******	******	******	******	******	******	******	******	0.0	******
CA	0.001	0.0	0.007	0.0	0.004	0.005	0.002	0.003	0.001	0.0
MN	******	******	******	******	******	******	******	******	0.006	******
ZN	0.0	0.001	0.0	0.0	0.000	******	******	******	******	******
FE2	0.406	0.318	0.364	0.328	0.387	0.373	0.398	0.467	0.487	0.321
MG	0.582	0.670	0.621	0.661	0.598	0.622	0.600	0.530	0.496	0.679

MOLAR RATIOS

CR/(CR+AL+FE3)	0.726	0.393	0.406	0.346	0.495	0.432	0.405	0.417	0.617	0.387
MG/(MG+FE2)	0.589	0.678	0.630	0.668	0.607	0.625	0.601	0.532	0.504	0.679
CR/FE	3.1	2.2	1.9	1.8	2.2	2.2	1.8	1.5	2.3	2.3

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 53.13 SD: 4.95

HIGH AL MEAN: 35.68 SD: 2.99

****** NOT ANALYZED

MICROPRORE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	31	32	33	34	35	36	37	38	39	40
CR2O3	49.63	48.96	50.51	50.09	31.25	34.62	38.01	39.79	41.21	46.69
AL2O3	18.73	18.41	18.55	19.12	39.05	34.82	31.93	31.30	26.56	20.06
FE2O3	4.12	4.49	2.21	1.98	1.04	1.58	1.55	1.04	3.26	2.71
SIO2	0.0	0.09	0.15	0.0	0.0	0.0	0.23	0.0	0.08	0.11
TIO2	0.25	0.23	******	******	******	******	******	0.23	0.16	******
NIO	0.15	0.11	******	******	******	******	******	0.21	0.22	******
NA2O	0.0	0.0	******	******	******	******	******	******	******	******
CAO	0.0	0.0	0.08	0.08	0.0	0.0	0.05	0.0	0.02	0.06
ZNO	******	******	******	******	******	******	******	0.03	0.07	******
FEO	14.78	15.69	17.48	15.58	13.07	13.60	15.54	13.25	16.71	15.61
MGO	12.97	12.33	11.55	12.54	16.65	15.71	14.44	15.38	12.56	12.25
TOTAL	100.63	100.31	100.73	99.39	101.06	100.33	101.75	101.23	100.85	97.49

NUMBER CATIONS / 4 OXYGENS

CR	1.218	1.211	1.253	1.244	0.691	0.786	0.869	0.910	0.981	1.176
AL	0.686	0.679	0.688	0.708	1.287	1.179	1.088	1.067	0.942	0.753
FE3	0.096	0.106	0.052	0.047	0.022	0.034	0.034	0.023	0.074	0.065
SI	0.0	0.003	0.005	0.000	0.0	0.0	0.007	0.0	0.003	0.004
TI	0.006	0.006	******	******	******	******	******	0.005	0.004	******
NI	0.004	0.003	******	******	******	******	******	0.005	0.006	******
NA	0.0	0.0	******	******	******	******	******	******	******	******
CA	0.0	0.0	0.003	0.003	0.0	0.0	0.002	0.0	0.001	0.002
ZN	******	******	******	******	******	******	******	0.001	0.002	******
FE2	0.384	0.410	0.458	0.409	0.306	0.327	0.376	0.321	0.421	0.416
MG	0.601	0.575	0.539	0.588	0.694	0.673	0.622	0.563	0.564	0.582

MOLAR RATIOS

CR/(CR+AL+FE3)	0.609	0.607	0.628	0.622	0.345	0.393	0.436	0.455	0.491	0.590
MG/(MG+FE2)	0.610	0.584	0.541	0.589	0.694	0.673	0.623	0.674	0.573	0.583
CR/FE	2.5	2.3	2.5	2.7	2.1	2.2	2.1	2.6	2.0	2.4

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 52.31 SD: 4.72

HIGH AL MEAN: 36.09 SD: 3.27

****** NOT ANALYZED

MICROPROBE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	41	42	43	44	45	46	47	48	49	50
CR2O3	39.15	44.22	36.42	37.75	42.13	36.89	34.75	35.39	57.64	55.26
AL2O3	30.68	24.52	31.99	30.53	28.96	34.55	36.03	34.35	11.52	11.39
FE2O3	2.12	2.51	2.41	2.53	0.93	0.0	0.81	2.10	3.02	2.51
V2O3	******	******	******	******	******	******	0.16	******	******	0.17
SIO2	0.17	0.06	0.08	0.01	0.0	0.0	0.12	0.13	1.68	0.21
TIO2	0.18	******	0.35	******	******	******	0.23	0.17	1.05	0.18
NIO	0.26	******	0.13	******	******	******	******	0.03	0.06	******
NA2O	******	******	******	******	******	******	******	0.0	******	******
CAO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.20	0.04
ZNO	0.01	******	0.01	******	******	******	0.0	******	0.0	0.02
FEO	14.29	15.78	14.36	13.99	13.82	15.07	15.49	16.56	17.33	16.39
MGO	14.77	13.23	14.45	14.87	15.10	14.42	14.84	14.07	10.39	10.51
TOTAL	101.63	100.32	100.20	99.68	100.94	100.93	102.43	102.80	102.89	96.68

NUMBER CATIONS / 4 OXYGENS

CR	0.898	1.062	0.842	0.881	0.978	0.840	0.776	0.797	1.431	1.470
AL	1.049	0.878	1.102	1.062	1.002	1.172	1.199	1.153	0.427	0.452
FE3	0.046	0.057	0.053	0.056	0.021	0.0	0.017	0.045	0.072	0.064
V	******	******	******	******	******	******	0.004	******	******	0.005
SI	0.005	0.002	0.003	0.000	0.0	0.0	0.004	0.004	0.053	0.007
TI	0.004	******	0.008	******	******	******	0.005	0.004	0.025	0.005
NI	0.006	******	0.003	******	******	******	******	0.001	0.002	******
NA	******	******	******	******	******	******	******	0.0	******	******
CA	0.0	0.0	0.0	0.000	0.0	0.0	0.0	0.0	0.007	0.002
ZN	0.000	******	0.000	******	******	******	0.0	******	0.0	0.001
FE2	0.347	0.401	0.351	0.345	0.339	0.353	0.366	0.395	0.455	0.461
MG	0.639	0.599	0.630	0.654	0.661	0.619	0.624	0.597	0.487	0.527

MOLAR RATIOS

CR/(CR+AL+FE3)	0.450	0.532	0.422	0.441	0.489	0.417	0.389	0.400	0.742	0.740
MG/(MG+FE2)	0.648	0.599	0.642	0.655	0.661	0.630	0.631	0.602	0.517	0.533
CR/FE	2.3	2.3	2.1	2.2	2.7	2.3	2.0	1.8	2.7	2.8

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 52.63 SD: 4.67

HIGH AL MEAN: 36.84 SD: 3.39

****** NOT ANALYZED

MICROPROBE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	51	52	53	54	55	56	57	58	59	60
CR2O3	39.65	39.66	39.55	31.43	32.94	43.29	51.50	51.98	53.68	43.26
AL2O3	27.71	28.11	27.92	37.37	36.31	27.37	18.53	2.60	17.98	27.00
FE2O3	3.20	2.83	3.30	3.11	1.89	1.85	0.53	12.42	0.19	2.69
V2O3	0.22	0.20	******	******	******	******	******	******	******	******
SIO2	0.21	0.34	0.19	0.0	0.01	0.12	0.08	0.57	0.02	0.10
TIO2	0.50	0.48	0.40	0.33	******	0.09	0.11	0.11	0.13	0.21
NIO	******	******	0.11	0.13	******	0.17	0.11	0.21	0.19	0.19
NA2O	0.0	0.0	0.0	0.0	******	******	******	******	******	******
CAO	0.08	0.0	0.0	0.0	0.02	0.0	0.0	0.0	0.0	0.0
ZNO	******	******	******	******	******	0.02	0.0	0.08	0.0	0.0
FEO	17.41	16.46	17.55	13.28	14.26	14.40	16.74	29.63	16.48	13.24
MGO	12.10	12.83	12.10	16.02	15.55	14.55	11.59	1.30	11.92	15.12
TOTAL	101.08	100.91	101.32	101.67	100.98	101.85	99.19	98.90	100.59	101.81

NUMBER CATIONS / 4 OXYGENS

CR	0.937	0.933	0.936	0.698	0.741	1.006	1.291	1.514	1.330	1.003
AL	0.977	0.985	0.982	1.237	1.218	0.948	0.693	0.113	0.664	0.933
FE3	0.072	0.063	0.074	0.066	0.040	0.041	0.013	0.344	0.005	0.059
V	0.005	0.005	******	******	******	******	******	******	******	******
SI	0.006	0.010	0.006	0.0	0.000	0.004	0.003	0.021	0.001	0.003
TI	0.011	0.011	0.009	0.007	******	0.002	0.003	0.003	0.003	0.005
NI	******	******	0.003	0.003	******	0.004	0.003	0.006	0.005	0.005
NA	0.0	0.0	0.0	0.0	******	******	******	******	******	******
CA	0.003	0.0	0.0	0.0	0.001	0.0	0.0	0.0	0.0	0.0
ZN	******	******	******	******	******	0.001	0.0	0.002	0.0	0.0
FE2	0.435	0.409	0.441	0.312	0.339	0.354	0.444	0.913	0.432	0.325
MG	0.539	0.569	0.539	0.671	0.660	0.638	0.548	0.072	0.557	0.661

MOLAR RATIOS

CR/(CR+AL+FE3)	0.472	0.471	0.470	0.349	0.371	0.504	0.647	0.768	0.665	0.503
MG/(MG+FE2)	0.553	0.581	0.550	0.683	0.660	0.643	0.552	0.073	0.563	0.670
CR/FE	1.8	2.0	1.8	1.8	2.0	2.5	2.8	1.2	3.0	2.6

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 52.60 SD: 4.43

HIGH AL MEAN: 37.22 SD: 3.70

****** NOT ANALYZED

MICROPROBE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	51	62	63	64	65	66	67	68	69	70
CR2O3	57.71	39.72	35.32	35.52	35.00	35.94	36.40	55.30	52.47	58.95
AL2O3	14.30	31.29	33.14	33.04	35.01	35.01	7.52	14.91	17.53	10.07
FE2O3	0.60	1.44	1.86	1.90	2.27	1.94	11.89	1.42	1.42	1.32
SIO2	0.10	0.0	0.04	0.23	0.0	0.0	8.83	0.25	0.03	0.14
TIO2	0.11	0.06	0.26	0.16	0.10	0.10	0.18	******	******	0.08
NIO	0.10	0.08	0.12	0.13	0.29	0.20	0.11	******	******	0.07
NA2O	******	******	******	******	******	******	******	******	******	0.0
CAO	0.0	0.0	0.0	0.0	0.0	0.0	0.01	0.0	0.08	0.0
ZNO	0.0	0.03	0.0	0.03	0.03	0.02	0.02	******	******	******
FEO	13.94	15.76	14.52	15.50	13.72	13.32	10.80	15.96	14.30	16.33
MGO	13.16	14.29	14.47	14.37	15.71	16.16	13.24	12.07	13.13	10.72
TOTAL	100.02	102.67	99.73	101.88	102.13	102.69	89.00	99.91	98.96	97.68

NUMBER CATIONS / 4 OXYGENS

CR	1.447	0.906	0.816	0.830	0.783	0.799	0.986	1.394	1.311	1.562
AL	0.534	1.063	1.141	1.120	1.168	1.150	0.304	0.561	0.653	0.398
FE3	0.014	0.031	0.041	0.041	0.048	0.041	0.307	0.034	0.034	0.033
SI	0.003	0.0	0.001	0.007	0.0	0.0	0.303	0.008	0.001	0.005
TI	0.003	0.001	0.006	0.004	0.002	0.002	0.005	******	******	0.002
NI	0.003	0.002	0.003	0.003	0.007	0.005	0.003	******	******	0.002
NA	******	******	******	******	******	******	******	******	******	0.0
CA	0.0	0.0	0.0	0.0	0.0	0.0	0.001	0.0	0.003	0.0
ZN	0.0	0.001	0.0	0.001	0.001	0.001	0.001	******	******	******
FE2	0.370	0.380	0.355	0.373	0.325	0.313	0.310	0.426	0.378	0.458
MG	0.622	0.614	0.630	0.616	0.663	0.677	0.677	0.574	0.619	0.536

MOLAR RATIOS

CR/(CR+AL+FE3)	0.725	0.453	0.408	0.417	0.392	0.399	0.618	0.701	0.656	0.784
MG/(MG+FE2)	0.627	0.618	0.640	0.623	0.671	0.684	0.686	0.574	0.621	0.539
CR/FE	3.8	2.2	2.1	2.0	2.1	2.3	1.6	3.0	3.2	3.2

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 53.03 SD: 4.39

HIGH AL MEAN: 37.10 SD: 3.45

****** NOT ANALYZED

MICROPROBE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	71	72	73	74	75	76	77	78	79	80
CR2O3	58.53	50.58	50.97	50.42	53.02	59.19	51.79	55.02	52.28	50.54
AL2O3	10.78	14.03	12.92	13.07	12.50	10.09	13.54	14.20	15.24	20.23
FE2O3	1.91	5.52	5.28	5.70	4.52	1.67	5.22	1.05	3.05	0.54
SIO2	0.0	0.08	0.25	0.23	0.0	0.19	0.0	0.32	0.0	0.12
TIO2	0.08	0.28	0.40	0.38	0.31	0.16	0.25	0.18	0.15	0.11
NIO	0.06	0.06	0.10	0.11	0.06	0.05	0.08	0.07	0.12	0.06
NA2O	0.0	0.0	0.0	0.0	0.0	0.0	******	0.0	0.0	0.0
CAO	0.0	0.0	0.02	0.02	0.0	0.0	0.01	0.0	0.0	0.0
ZNO	******	******	******	******	******	******	0.04	******	******	******
FEO	15.44	20.38	18.32	19.77	17.22	14.98	18.31	16.25	18.82	15.65
MGO	11.49	8.63	9.31	8.52	10.13	11.59	9.79	11.27	9.88	12.66
TOTAL	98.29	99.56	97.57	98.22	97.76	97.93	99.03	98.36	99.54	99.91

NUMBER CATIONS / 4 OXYGENS

CR	1.532	1.315	1.347	1.332	1.396	1.555	1.346	1.415	1.342	1.241
AL	0.421	0.544	0.509	0.515	0.491	0.395	0.525	0.545	0.583	0.741
FE3	0.048	0.137	0.133	0.143	0.113	0.042	0.129	0.026	0.075	0.013
SI	0.0	0.003	0.009	0.008	0.0	0.006	0.0	0.010	0.0	0.004
TI	0.002	0.007	0.010	0.010	0.008	0.004	0.006	0.004	0.004	0.003
NI	0.002	0.002	0.003	0.003	0.002	0.002	0.002	0.002	0.003	0.002
NA	0.0	0.0	0.0	0.0	0.0	0.0	******	0.0	0.0	0.0
CA	0.0	0.0	0.001	0.001	0.0	0.0	0.000	0.0	0.0	0.0
ZN	******	******	******	******	******	******	0.001	******	******	******
FE2	0.427	0.561	0.512	0.552	0.480	0.416	0.503	0.442	0.511	0.406
MG	0.567	0.424	0.464	0.424	0.503	0.574	0.480	0.547	0.478	0.586

MOLAR RATIOS

CR/(CR+AL+FE3)	0.766	0.659	0.677	0.669	0.698	0.781	0.673	0.713	0.671	0.622
MG/(MG+FE2)	0.570	0.430	0.475	0.434	0.512	0.580	0.488	0.553	0.483	0.591
CR/FE	3.2	1.9	2.1	1.9	2.4	3.4	2.1	3.0	2.3	3.0

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 53.07 SD: 4.12

HIGH AL MEAN: 37.10 SD: 3.45

****** NOT ANALYZED

MICROPRORE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	81	82	83	84	85	86	87	88	89	90
CR2O3	53.42	56.65	58.98	55.43	58.49	52.98	53.80	57.57	58.37	57.96
AL2O3	15.68	11.84	9.86	10.37	9.44	12.50	14.37	11.50	13.07	11.75
FE2O3	0.87	1.41	2.00	2.70	2.50	4.32	2.96	1.53	0.06	1.69
SIO2	0.17	0.10	0.10	0.25	0.32	0.02	0.08	0.02	0.02	0.12
TIO2	0.10	0.25	0.18	0.15	0.20	0.23	0.30	0.18	0.16	0.26
NIO	0.02	0.20	0.05	0.13	0.03	0.03	0.07	0.15	0.13	0.12
NA2O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAO	0.0	0.0	0.0	0.09	0.0	0.0	0.0	0.01	0.0	0.0
FEO	15.79	16.17	16.61	19.98	18.53	16.98	14.42	19.69	16.05	13.95
MGO	12.08	10.67	10.56	8.09	9.40	10.31	12.30	8.88	11.42	12.33
TOTAL	99.13	97.29	98.34	97.19	98.91	97.37	98.30	99.53	99.28	98.18

NUMBER CATIONS / 4 OXYGENS

CR	1.345	1.494	1.557	1.500	1.549	1.398	1.376	1.511	1.497	1.500
AL	0.626	0.466	0.388	0.418	0.373	0.492	0.548	0.450	0.500	0.453
FE3	0.021	0.036	0.050	0.070	0.063	0.109	0.072	0.038	0.002	0.042
SI	0.005	0.004	0.004	0.009	0.011	0.001	0.003	0.001	0.001	0.004
TI	0.002	0.006	0.005	0.004	0.005	0.006	0.007	0.006	0.004	0.007
NI	0.001	0.005	0.001	0.004	0.001	0.001	0.002	0.004	0.004	0.003
NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CA	0.0	0.0	0.0	0.004	0.0	0.0	0.0	0.000	0.0	0.0
FE2	0.421	0.451	0.464	0.572	0.519	0.474	0.390	0.547	0.436	0.382
MG	0.574	0.531	0.526	0.413	0.470	0.513	0.593	0.440	0.553	0.602

MOLAR RATIOS

CR/(CR+AL+FE3)	0.675	0.749	0.780	0.754	0.780	0.699	0.689	0.756	0.749	0.752
MG/(MG+FE2)	0.577	0.541	0.531	0.419	0.475	0.520	0.603	0.446	0.559	0.612
CR/FE	3.0	3.1	3.0	2.3	2.7	2.4	3.0	2.6	3.4	3.5

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 53.70 SD: 4.04

HIGH AL MEAN: 37.10 SD: 3.45

****** NOT ANALYZED

MICROPROBE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	91	92	93	94	95	96	97	98	99	100
CR2O3	53.34	61.80	52.97	54.94	18.96	32.44	51.34	50.02	52.00	56.65
AL2O3	12.30	9.86	14.50	14.46	52.64	37.45	18.89	19.53	15.02	10.37
FE2O3	1.82	0.0	2.56	1.59	0.0	0.0	0.0	0.19	2.29	3.84
SIO2	0.04	0.47	0.03	0.12	0.0	0.0	0.04	0.0	0.08	0.08
TIO2	0.15	0.11	0.0	0.19	0.0	0.0	0.11	0.08	0.28	0.28
NIO	0.15	0.15	0.09	0.05	0.01	0.13	0.05	0.07	0.06	0.02
NA2O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	******
CAO	0.0	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.01
ZNO	******	******	******	******	******	******	******	******	******	0.02
FEO	12.62	14.13	17.96	14.90	16.02	18.22	18.52	19.45	10.19	17.04
MGO	13.49	12.28	10.32	12.15	15.31	13.08	10.36	9.99	14.30	10.24
TOTAL	98.91	98.81	98.53	98.40	102.94	101.32	99.31	99.33	94.22	98.55

NUMBER CATIONS / 4 OXYGENS

CR	1.487	1.601	1.372	1.404	0.395	0.735	1.293	1.261	1.356	1.492
AL	0.467	0.381	0.560	0.551	1.635	1.265	0.710	0.734	0.584	0.407
FE3	0.044	0.0	0.056	0.039	0.0	0.0	0.0	0.005	0.057	0.096
SI	0.001	0.015	0.001	0.004	0.0	0.0	0.001	0.0	0.003	0.003
TI	0.004	0.003	0.000	0.005	0.0	0.0	0.003	0.002	0.007	0.007
NI	0.004	0.004	0.003	0.002	0.000	0.003	0.001	0.002	0.002	0.001
NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	******
CA	0.0	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.000
ZN	******	******	******	******	******	******	******	******	******	0.001
FE2	0.340	0.387	0.492	0.403	0.353	0.437	0.494	0.519	0.281	0.475
MG	0.648	0.600	0.504	0.586	0.602	0.559	0.492	0.475	0.703	0.509

MOLAR RATIOS

CR/(CR+AL+FE3)	0.744	0.808	0.687	0.704	0.195	0.368	0.646	0.631	0.679	0.748
MG/(MG+FE2)	0.656	0.608	0.506	0.593	0.630	0.561	0.499	0.478	0.714	0.517
CR/FE	3.9	4.1	2.5	3.2	1.1	1.7	2.6	2.4	4.0	2.6

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 53.83 SD: 4.02

HIGH AL MEAN: 36.52 SD: 4.49

****** NOT ANALYZED

MICROPROBE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	101	102	103	104	105	106	107	108	109	110
CR2O3	37.57	31.00	31.45	32.62	58.50	39.46	60.81	35.47	34.09	34.91
AL2O3	32.95	35.95	35.96	34.50	10.63	31.29	8.08	35.41	36.69	28.77
FE2O3	1.72	4.21	4.55	3.71	2.07	1.24	1.61	1.48	1.79	5.02
SIO2	0.08	0.14	0.0	0.0	0.03	0.17	0.07	0.07	0.02	0.0
TIO2	******	0.70	0.56	0.79	0.15	0.18	******	0.15	0.27	******
NIO	******	0.03	0.13	0.10	0.08	0.17	******	0.17	0.22	******
NA2O	******	0.0	0.0	0.0	0.0	0.0	******	0.0	0.0	******
CAO	0.0	0.0	0.0	0.01	0.0	0.11	0.02	0.0	0.0	0.0
FEO	13.83	13.55	13.35	15.60	14.77	12.59	15.77	12.91	11.39	7.90
MGO	15.70	15.22	15.56	13.59	11.77	15.80	10.89	16.31	17.22	17.46
TOTAL	101.85	100.80	101.56	100.92	98.00	101.01	97.25	101.97	101.69	94.06

NUMBER CATIONS / 4 OXYGENS

CR	0.849	0.698	0.704	0.745	1.531	0.901	1.632	0.790	0.753	0.846
AL	1.110	1.206	1.199	1.174	0.415	1.065	0.324	1.176	1.208	1.039
FE3	0.037	0.090	0.097	0.081	0.052	0.027	0.041	0.031	0.038	0.116
SI	0.002	0.004	0.0	0.0	0.001	0.005	0.002	0.002	0.001	0.0
TI	******	0.015	0.012	0.017	0.004	0.004	******	0.003	0.006	******
NI	******	0.001	0.003	0.003	0.002	0.004	******	0.004	0.005	******
NA	******	0.0	0.0	0.0	0.0	0.0	******	0.0	0.0	******
CA	0.0	0.0	0.0	0.001	0.000	0.003	0.001	0.0	0.000	0.000
FE2	0.331	0.323	0.316	0.377	0.409	0.304	0.448	0.304	0.266	0.203
MG	0.669	0.646	0.657	0.585	0.581	0.680	0.551	0.685	0.717	0.797

MOLAR RATIOS

CR/(CR+AL+FE3)	0.425	0.350	0.352	0.372	0.766	0.452	0.817	0.396	0.377	0.423
MG/(MG+FE2)	0.669	0.667	0.575	0.608	0.587	0.691	0.552	0.692	0.729	0.797
CR/FE	2.3	1.7	1.7	1.6	3.3	2.7	3.3	2.4	2.5	2.7

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 54.02 SD: 4.09

HIGH AL MEAN: 36.19 SD: 4.30

****** NOT ANALYZED

MICROPROBE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	111	112	113	114	115	116	117	118	119	120
CR2O3	55.10	55.55	35.31	36.51	54.51	39.50	58.47	56.10	57.89	18.36
AL2O3	12.18	13.86	35.59	28.55	14.64	30.83	9.31	12.88	10.84	51.16
FE2O3	3.16	1.29	1.32	4.53	1.23	2.20	1.64	1.65	2.72	0.0
SIO2	0.07	0.04	0.10	0.10	0.19	0.07	0.16	0.05	0.10	0.14
TIO2	******	0.15	0.15	******	******	0.31	******	0.16	0.21	0.04
NIO	******	0.06	0.05	******	******	0.19	******	0.10	0.09	0.10
NA2O	******	0.0	0.0	******	******	0.0	******	0.0	0.0	0.0
CAO	0.0	0.02	0.0	0.01	0.02	0.04	0.06	0.0	0.0	0.23
FEO	14.74	15.49	12.77	9.44	13.50	12.54	14.29	15.34	14.44	15.37
MGO	11.98	11.65	15.46	16.84	13.04	15.71	11.60	11.59	12.00	16.25
TOTAL	97.23	98.11	101.75	95.98	97.13	101.49	95.53	97.87	98.29	101.65

NUMBER CATIONS / 4 OXYGENS

CR	1.442	1.433	0.786	0.874	1.401	0.901	1.576	1.458	1.507	0.387
AL	0.476	0.533	1.182	1.019	0.561	1.048	0.374	0.499	0.421	1.608
FE3	0.079	0.032	0.028	0.103	0.030	0.048	0.042	0.041	0.068	0.0
SI	0.003	0.002	0.003	0.003	0.006	0.002	0.005	0.002	0.004	0.004
TI	******	0.004	0.003	******	******	0.007	******	0.004	0.005	0.001
NI	******	0.002	0.001	******	******	0.005	******	0.003	0.002	0.002
NA	******	0.0	0.0	******	******	0.0	******	0.0	0.0	0.0
CA	0.000	0.001	0.0	0.001	0.001	0.001	0.003	0.000	0.000	0.007
FE2	0.408	0.423	0.301	0.239	0.367	0.305	0.408	0.421	0.398	0.343
MG	0.592	0.567	0.691	0.760	0.632	0.676	0.590	0.568	0.589	0.646

MOLAR RATIOS

CR/(CR+AL+FE3)	0.722	0.717	0.394	0.438	0.703	0.451	0.791	0.730	0.755	0.194
MG/(MG+FE2)	0.592	0.573	0.697	0.761	0.633	0.689	0.591	0.574	0.597	0.653
CR/FE	3.0	3.2	2.4	2.6	3.5	2.6	3.5	3.2	3.2	1.1

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 54.22 SD: 3.98

HIGH AL MEAN: 35.89 SD: 4.85

****** NOT ANALYZED

MICROPROBE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	121	122	123	124	125	126	127	128	129	130
CR2O3	14.60	18.54	21.77	37.63	27.27	37.92	44.56	41.87	34.37	26.02
AL2O3	55.89	51.58	46.80	29.33	40.30	30.21	23.22	24.07	34.46	43.00
FE2O3	0.0	0.66	1.79	3.68	2.17	2.55	2.23	3.96	2.38	1.27
V2O3	******	******	******	******	******	******	******	******	******	0.10
SIO2	0.21	0.12	0.04	0.11	0.08	0.10	0.17	0.14	0.04	0.16
TIO2	0.05	0.01	0.03	0.25	0.16	0.21	0.20	0.76	0.28	0.28
NIO	0.15	0.12	0.07	0.13	0.15	0.11	0.07	******	******	0.06
NA2O	0.0	0.0	0.0	0.0	0.01	0.0	0.0	******	******	0.0
CAO	0.26	0.18	0.09	0.12	0.0	0.0	0.0	0.12	0.02	0.12
MNO	******	******	******	******	******	******	******	0.27	0.18	******
FEO	10.79	12.77	12.94	15.97	14.26	16.55	17.54	15.62	12.83	13.04
MGO	18.88	18.15	17.34	13.17	15.50	13.09	11.55	11.90	15.75	16.58
TOTAL	101.83	102.13	100.87	100.39	99.90	100.94	99.54	98.71	100.31	100.63

NUMBER CATIONS / 4 OXYGENS

CR	0.296	0.385	0.457	0.885	0.609	0.885	1.092	1.024	0.780	0.567
AL	1.720	1.597	1.495	1.028	1.342	1.051	0.848	0.878	1.166	1.397
FE3	0.0	0.013	0.037	0.082	0.046	0.059	0.052	0.092	0.052	0.026
V	******	******	******	******	******	******	******	******	******	0.002
SI	0.005	0.003	0.001	0.004	0.002	0.003	0.005	0.005	0.001	0.005
TI	0.001	0.000	0.001	0.006	0.004	0.005	0.005	0.018	0.006	0.006
NI	0.003	0.003	0.002	0.003	0.003	0.003	0.002	******	******	0.002
NA	0.0	0.0	0.0	0.0	0.001	0.0	0.0	******	******	0.0
CA	0.007	0.005	0.003	0.004	0.0	0.0	0.0	0.004	0.001	0.004
MN	******	******	******	******	******	******	******	0.007	0.004	******
FE2	0.231	0.281	0.293	0.397	0.337	0.411	0.455	0.404	0.308	0.301
MG	0.722	0.711	0.701	0.584	0.653	0.577	0.534	0.549	0.674	0.682

MOLAR RATIOS

CR/(CR+AL+FE3)	0.147	0.193	0.234	0.443	0.305	0.444	0.548	0.514	0.391	0.285
MG/(MG+FE2)	0.757	0.717	0.705	0.595	0.660	0.584	0.540	0.576	0.686	0.694
CR/FE	1.3	1.3	1.4	1.8	1.6	1.9	2.2	2.1	2.2	1.7

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 54.08 SD: 4.11

HIGH AL MEAN: 34.84 SD: 6.22

****** NOT ANALYZED

MICROPROBE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	131	132	133	134	135	136	137	138	139	140
CR2O3	34.08	22.50	30.56	35.38	29.08	35.38	40.47	41.31	33.53	46.78
AL2O3	32.60	39.28	37.92	31.88	40.87	31.89	24.94	25.90	33.75	20.02
FE2O3	2.83	5.83	0.92	3.75	0.78	3.73	4.30	3.11	3.75	3.21
SIO2	0.13	0.23	0.14	0.11	0.14	0.12	0.14	0.15	0.0	0.21
TIO2	0.38	******	0.15	0.55	0.48	0.55	0.68	0.64	0.64	0.53
NIO	0.06	******	0.05	0.08	0.07	0.08	0.08	0.14	0.19	0.11
NA2O	0.0	******	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAO	0.16	0.01	0.12	0.02	0.13	0.02	0.01	0.0	0.0	0.0
FEO	14.82	21.63	14.06	14.88	13.58	14.89	17.68	15.83	13.37	16.41
MGO	13.83	10.92	15.23	14.00	15.88	14.01	11.07	12.43	14.91	11.42
TOTAL	98.89	100.40	99.15	100.65	101.01	100.67	99.37	99.51	100.14	98.69

NUMBER CATIONS / 4 OXYGENS

CR	0.796	0.517	0.693	0.816	0.639	0.815	0.987	0.994	0.767	1.169
AL	1.135	1.346	1.282	1.097	1.339	1.097	0.907	0.929	1.151	0.746
FE3	0.063	0.128	0.020	0.082	0.016	0.082	0.100	0.071	0.082	0.076
SI	0.004	0.007	0.004	0.004	0.004	0.004	0.005	0.005	0.0	0.007
TI	0.009	******	0.003	0.012	0.010	0.012	0.016	0.015	0.014	0.013
NI	0.002	******	0.001	0.002	0.002	0.002	0.002	0.004	0.005	0.003
NA	0.0	******	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CA	0.005	0.000	0.004	0.001	0.004	0.001	0.000	0.0	0.0	0.0
FE2	0.366	0.526	0.337	0.363	0.316	0.354	0.456	0.403	0.324	0.434
MG	0.609	0.474	0.651	0.609	0.658	0.609	0.509	0.564	0.643	0.538

MOLAR RATIOS

CR/(CR+AL+FE3)	0.399	0.260	0.347	0.409	0.320	0.409	0.495	0.498	0.384	0.587
MG/(MG+FE2)	0.625	0.474	0.559	0.627	0.676	0.626	0.527	0.583	0.665	0.554
CR/FE	1.9	0.8	1.9	1.8	1.9	1.8	1.8	2.1	1.9	2.3

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 53.97 SD: 4.17

HIGH AL MEAN: 34.68 SD: 6.14

****** NOT ANALYZED

MICROPROBE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	141	142	143	144	145	146	147	148	149	150
CR2O3	39.72	28.86	37.88	43.71	33.20	23.10	41.09	36.87	29.59	47.41
AL2O3	28.19	39.69	30.47	25.56	34.35	48.08	25.16	29.15	39.28	20.84
FE2O3	3.31	1.84	2.36	1.67	2.19	0.0	2.97	4.73	1.46	5.44
SIO2	0.21	0.10	0.08	0.10	0.17	0.27	0.10	0.04	0.04	0.04
TIO2	0.66	0.11	0.43	0.28	0.40	0.08	0.40	******	******	******
NIO	0.08	0.02	0.01	0.05	0.11	0.01	0.11	******	******	******
NA2O	0.0	0.0	0.0	0.0	0.0	0.01	0.0	******	******	******
CAO	0.0	0.29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.22
FEO	15.10	12.16	15.49	16.85	14.42	10.11	15.91	10.70	15.14	10.18
MGO	13.41	16.69	13.59	12.40	14.45	18.55	12.25	17.04	15.27	16.33
TOTAL	100.68	99.76	100.31	100.62	99.29	100.21	97.99	100.53	100.78	100.46

NUMBER CATIONS / 4 OXYGENS

CR	0.932	0.642	0.884	1.046	0.755	0.490	1.007	0.895	0.660	1.132
AL	0.986	1.315	1.060	0.912	1.180	1.519	0.919	1.000	1.307	0.742
FE3	0.074	0.039	0.053	0.038	0.048	0.0	0.069	0.104	0.031	0.124
SI	0.006	0.003	0.003	0.003	0.005	0.007	0.003	0.001	0.001	0.001
TI	0.015	0.002	0.010	0.006	0.009	0.002	0.009	******	******	******
NI	0.002	0.001	0.000	0.001	0.003	0.000	0.003	******	******	******
NA	0.0	0.0	0.0	0.0	0.0	0.001	0.0	******	******	******
CA	0.0	0.009	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.007
FE2	0.375	0.286	0.382	0.426	0.352	0.227	0.412	0.261	0.358	0.257
MG	0.593	0.700	0.598	0.559	0.628	0.741	0.566	0.739	0.642	0.735

MOLAR RATIOS

CR/(CR+AL+FE3)	0.468	0.321	0.443	0.524	0.384	0.244	0.505	0.448	0.330	0.567
MG/(MG+FE2)	0.613	0.710	0.610	0.567	0.641	0.766	0.578	0.739	0.642	0.741
CR/FE	2.1	2.0	2.0	2.3	1.9	2.2	2.1	2.5	1.7	3.0

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 53.88 SD: 4.22

HIGH AL MEAN: 34.73 SD: 6.17

****** NOT ANALYZED

MICROPROBE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	151	152	153	154	155	156	157	158	159	160
CR2O3	22.49	31.04	30.86	33.06	38.93	26.03	33.42	35.51	31.24	34.65
AL2O3	47.10	35.16	36.97	34.63	28.51	42.72	33.48	30.15	33.89	31.97
FE2O3	1.73	2.77	3.17	2.75	2.75	0.96	3.80	4.20	4.81	3.26
SIO2	0.02	0.12	0.08	0.02	0.04	0.52	0.10	0.08	0.06	0.10
TIO2	0.20	0.32	0.31	0.33	0.40	0.20	0.45	0.83	0.50	0.18
NIO	0.13	0.07	0.11	0.07	0.11	0.07	0.05	0.03	******	******
NA2O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.04	0.09
CAO	0.01	0.0	0.04	0.04	0.05	0.05	0.0	0.0	0.0	0.22
MNO	******	******	******	******	******	******	******	******	0.29	0.28
FEO	10.50	13.93	12.62	13.19	15.16	12.22	17.10	17.73	17.12	16.33
MGO	18.85	15.09	16.15	15.35	13.29	17.16	13.03	11.65	12.65	13.03
TOTAL	101.03	99.50	100.31	99.44	99.24	100.04	101.43	100.28	100.60	100.11

NUMBER CATIONS / 4 OXYGENS

CR	0.477	0.707	0.692	0.757	0.926	0.558	0.767	0.841	0.723	0.810
AL	1.488	1.228	1.236	1.182	1.010	1.389	1.146	1.061	1.169	1.113
FE3	0.035	0.060	0.068	0.060	0.062	0.020	0.083	0.095	0.106	0.073
SI	0.001	0.004	0.002	0.001	0.001	0.017	0.003	0.003	0.002	0.003
TI	0.004	0.007	0.007	0.007	0.009	0.004	0.010	0.019	0.011	0.004
NI	0.003	0.002	0.003	0.002	0.003	0.002	0.001	0.001	******	******
NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.002	0.005
CA	0.000	0.0	0.001	0.001	0.002	0.002	0.0	0.0	0.0	0.007
MN	******	******	******	******	******	******	******	******	0.007	0.007
FE2	0.235	0.336	0.300	0.320	0.381	0.252	0.415	0.443	0.419	0.404
MG	0.753	0.648	0.683	0.663	0.596	0.706	0.564	0.519	0.552	0.574

MOLAR RATIOS

CR/(CR+AL+FE3)	0.238	0.354	0.347	0.379	0.463	0.287	0.384	0.421	0.362	0.406
MG/(MG+FE2)	0.762	0.659	0.695	0.675	0.610	0.714	0.576	0.539	0.568	0.587
CR/FE	1.8	1.8	1.9	2.0	2.1	1.9	1.5	1.6	1.4	1.7

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 53.88 SD: 4.22

HIGH AL MEAN: 34.39 SD: 6.07

****** NOT ANALYZED

MICROPROBE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	161	162	163	164	165	166	167	168	169	170
CR2O3	40.03	25.53	38.00	40.66	38.55	50.24	53.18	52.17	50.62	61.21
AL2O3	28.43	44.93	25.79	26.68	27.80	14.62	12.33	14.41	13.34	8.55
FE2O3	2.02	0.0	5.80	3.35	3.69	4.57	3.96	4.04	5.04	0.84
SIO2	0.0	0.0	0.0	0.14	0.17	0.14	0.19	0.0	0.17	0.0
TIO2	0.28	0.06	0.96	0.43	0.65	0.23	0.23	0.25	0.26	0.10
NIO	******	******	0.10	******	0.10	0.07	0.05	0.06	0.01	0.16
NA2O	0.12	0.05	0.0	0.13	0.0	0.0	******	******	******	0.0
CAO	0.04	0.0	0.0	0.13	0.0	0.0	0.0	0.0	0.01	0.0
MNO	0.21	0.09	******	0.21	******	******	******	******	******	******
ZNO	******	******	******	******	******	******	0.01	0.03	0.04	******
FEO	13.25	10.93	16.61	13.67	18.10	20.83	17.91	18.16	21.91	14.17
MGO	14.49	17.12	11.64	13.91	11.34	8.39	9.75	10.06	7.44	11.69
TOTAL	98.87	98.71	99.90	99.32	100.40	99.19	97.61	99.18	98.84	96.72

NUMBER CATIONS / 4 OXYGENS

CR	0.949	0.559	0.917	0.969	0.920	1.309	1.406	1.346	1.339	1.637
AL	1.005	1.465	0.927	0.948	0.989	0.563	0.486	0.554	0.526	0.341
FE3	0.046	0.0	0.156	0.076	0.084	0.115	0.100	0.099	0.127	0.022
SI	0.0	0.0	0.0	0.005	0.005	0.005	0.006	0.0	0.006	0.0
TI	0.006	0.001	0.022	0.010	0.015	0.006	0.006	0.006	0.007	0.003
NI	******	******	0.002	******	0.003	0.002	0.001	0.002	0.000	0.005
NA	0.007	0.003	0.0	0.008	0.0	0.0	******	******	******	0.0
CA	0.001	0.0	0.0	0.005	0.0	0.0	0.0	0.0	0.001	0.0
MN	0.006	0.002	******	0.006	******	******	******	******	******	******
ZN	******	******	******	******	******	******	0.000	0.001	0.001	******
FE2	0.332	0.253	0.424	0.345	0.457	0.574	0.501	0.496	0.613	0.401
MG	0.648	0.706	0.529	0.625	0.510	0.412	0.486	0.490	0.371	0.589

MOLAR RATIOS

CR/(CR+AL+FE3)	0.475	0.276	0.458	0.486	0.462	0.657	0.706	0.673	0.672	0.819
MG/(MG+FE2)	0.661	0.736	0.555	0.644	0.528	0.418	0.492	0.497	0.377	0.595
CR/FE	2.5	2.2	1.6	2.3	1.7	1.9	2.3	2.3	1.8	3.9

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 53.86 SD: 4.20

HIGH AL MEAN: 34.50 SD: 6.07

****** NOT ANALYZED

MICROPROBE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	171	172	173	174	175	176	177	178	179	180
CR2O3	35.52	42.34	31.73	44.75	9.85	22.66	38.39	35.18	20.72	34.24
AL2O3	30.96	23.75	36.77	19.93	60.23	48.31	16.89	34.37	50.56	35.54
FE2O3	2.98	3.84	1.82	4.86	1.60	0.23	12.86	1.45	0.0	1.59
SIO2	0.06	0.17	0.04	0.08	0.0	0.0	0.12	0.04	0.02	0.10
TIO2	0.26	0.38	0.03	0.36	0.0	0.03	******	******	******	******
NIO	0.11	0.08	0.03	0.11	0.17	0.10	******	******	******	******
NA2O	0.0	0.0	0.0	0.0	0.0	0.0	******	******	******	******
CAO	0.0	0.0	0.0	0.0	0.0	0.0	0.18	0.0	0.0	0.0
FEO	17.10	19.19	16.63	19.78	7.49	14.68	22.23	13.87	15.45	12.71
MGO	12.78	10.46	14.04	9.48	22.53	16.84	7.56	15.52	15.42	16.44
TOTAL	100.77	100.21	101.09	99.35	101.87	102.85	98.23	100.43	102.17	100.62

NUMBER CATIONS / 4 OXYGENS

CR	0.853	1.037	0.718	1.130	0.195	0.478	1.010	0.801	0.437	0.770
AL	1.078	0.867	1.241	0.750	1.775	1.518	0.662	1.166	1.590	1.192
FE3	0.066	0.090	0.039	0.117	0.030	0.005	0.322	0.031	0.0	0.034
SI	0.002	0.005	0.001	0.003	0.0	0.0	0.004	0.001	0.001	0.003
TI	0.006	0.009	0.001	0.009	0.0	0.001	******	******	******	******
NI	0.003	0.002	0.001	0.003	0.004	0.002	******	******	******	******
NA	0.0	0.0	0.0	0.0	0.0	0.0	******	******	******	******
CA	0.0	0.0	0.0	0.0	0.0	0.0	0.006	0.0	0.0	0.0
FE2	0.423	0.497	0.398	0.528	0.157	0.327	0.619	0.334	0.345	0.303
MG	0.563	0.483	0.599	0.451	0.840	0.669	0.375	0.666	0.613	0.697

MOLAR RATIOS

CR/(CR+AL+FE3)	0.427	0.520	0.359	0.566	0.097	0.239	0.506	0.401	0.216	0.386
MG/(MG+FE2)	0.571	0.493	0.601	0.461	0.843	0.672	0.377	0.666	0.640	0.697
CR/FE	1.7	1.8	1.6	1.8	1.0	1.4	1.1	2.2	1.3	2.3

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 53.74 SD: 4.30

HIGH AL MEAN: 34.12 SD: 6.60

****** NOT ANALYZED

MICROPROBE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	181	182	183	184	185	186	187	188	189	190
CR2O3	42.34	31.35	0.42	51.15	55.27	20.09	17.92	26.69	44.29	57.70
AL2O3	23.81	35.62	69.19	12.98	11.58	40.26	49.00	36.88	14.25	10.37
FE2O3	3.56	1.38	0.22	6.42	3.43	8.56	1.61	6.79	10.33	3.09
SIO2	0.23	0.33	0.09	0.14	0.01	0.23	0.28	0.04	0.07	0.13
TIO2	0.26	0.09	0.03	0.29	0.26	0.38	0.12	0.36	0.47	0.17
NIO	0.05	0.03	0.12	0.06	0.14	0.06	0.09	0.04	0.06	0.01
NA2O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAO	0.04	0.04	0.05	0.0	0.0	0.23	0.40	0.0	0.02	0.0
FEO	19.47	19.67	13.22	19.43	15.76	25.44	22.26	20.11	23.95	14.78
MGO	10.38	11.70	20.00	9.14	10.91	8.63	11.68	11.71	6.04	11.75
TOTAL	100.14	100.21	103.34	99.61	97.36	103.88	103.36	102.62	99.48	98.00

NUMBER CATIONS / 4 OXYGENS

CR	1.037	0.726	0.008	1.331	1.457	0.453	0.386	0.605	1.173	1.511
AL	0.870	1.230	1.984	0.504	0.455	1.354	1.571	1.246	0.563	0.405
FE3	0.083	0.031	0.004	0.159	0.086	0.184	0.033	0.147	0.260	0.077
SI	0.007	0.010	0.002	0.005	0.001	0.007	0.008	0.001	0.003	0.005
TI	0.006	0.002	0.001	0.007	0.007	0.008	0.003	0.008	0.012	0.004
NI	0.001	0.001	0.003	0.002	0.004	0.002	0.002	0.001	0.002	0.001
NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CA	0.002	0.002	0.002	0.0	0.0	0.007	0.012	0.0	0.001	0.000
FE2	0.504	0.482	0.259	0.535	0.440	0.607	0.507	0.482	0.671	0.410
MG	0.480	0.511	0.725	0.449	0.543	0.357	0.474	0.501	0.302	0.581

MOLAR RATIOS

CR/(CR+AL+FE3)	0.521	0.366	0.004	0.668	0.729	0.228	0.194	0.303	0.588	0.758
MG/(MG+FE2)	0.487	0.515	0.729	0.456	0.552	0.377	0.483	0.509	0.310	0.586
CR/FE	1.8	1.4	0.0	1.9	2.8	0.6	0.7	1.0	1.3	3.1

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 53.78 SD: 4.26

HIGH AL MEAN: 33.61 SD: 7.58

****** NOT ANALYZED

MICROPROBE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	191	192	193	194	195	196	197	198	199	200
CR2O3	49.47	57.19	58.27	50.55	58.13	35.92	56.38	58.22	45.11	56.18
AL2O3	14.01	10.55	10.68	12.53	10.62	27.38	11.95	10.78	11.50	9.30
FE2O3	5.32	3.01	3.00	6.89	2.98	6.59	3.06	3.19	12.47	4.16
SIO2	0.13	0.13	0.03	0.06	0.10	0.17	0.20	0.08	0.08	0.14
TIO2	0.33	0.14	0.15	0.26	0.18	0.20	0.30	0.18	0.25	0.20
NIO	0.05	0.02	0.09	0.08	0.07	0.19	0.07	0.18	0.07	0.13
NA2O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAO	0.0	0.0	0.0	0.0	0.0	0.15	0.0	0.01	0.0	0.0
FEO	24.20	15.41	13.57	22.02	15.72	23.50	13.80	12.65	23.22	20.70
MGO	5.36	11.34	12.62	7.45	11.35	8.47	12.44	13.14	6.37	7.78
TOTAL	100.87	97.79	98.41	99.84	99.15	102.57	98.20	98.43	99.07	98.59

NUMBER CATIONS / 4 OXYGENS

CR	1.291	1.504	1.511	1.332	1.510	0.852	1.455	1.503	1.215	1.513
AL	0.545	0.414	0.413	0.492	0.412	0.980	0.460	0.415	0.462	0.374
FE3	0.157	0.075	0.074	0.173	0.074	0.151	0.075	0.079	0.320	0.107
SI	0.005	0.005	0.001	0.002	0.004	0.005	0.007	0.003	0.003	0.005
TI	0.008	0.004	0.004	0.007	0.005	0.005	0.008	0.005	0.006	0.005
NI	0.002	0.001	0.003	0.002	0.002	0.005	0.002	0.005	0.002	0.004
NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CA	0.0	0.0	0.0	0.0	0.000	0.005	0.0	0.001	0.0	0.000
FE2	0.668	0.429	0.372	0.614	0.432	0.597	0.377	0.345	0.661	0.590
MG	0.313	0.563	0.617	0.370	0.556	0.384	0.606	0.640	0.324	0.395

MOLAR RATIOS

CR/(CR+AL+FE3)	0.648	0.755	0.756	0.667	0.757	0.433	0.731	0.753	0.608	0.759
MG/(MG+FE2)	0.319	0.567	0.624	0.376	0.563	0.391	0.616	0.649	0.329	0.401
CR/FE	1.6	3.0	3.4	1.7	3.0	1.2	3.2	3.5	1.2	2.2

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 53.84 SD: 4.29

HIGH AL MEAN: 33.63 SD: 7.55

****** NOT ANALYZED

MICROPROBE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	201	202	203	204	205	206	207	208	209	210
CR2O3	47.88	53.86	16.96	46.44	26.43	44.26	60.06	43.28	34.58	42.41
AL2O3	12.59	10.40	46.29	18.46	30.84	21.21	10.50	18.64	22.98	17.76
FE2O3	8.26	5.41	7.92	4.60	10.53	4.43	2.87	5.97	9.85	10.65
SIO2	0.09	0.17	0.10	0.14	0.22	0.11	0.04	0.12	0.10	0.10
TIO2	0.30	0.23	0.20	******	0.27	0.35	0.25	******	******	1.45
NIO	0.06	0.05	0.05	******	0.04	0.03	0.14	******	******	0.0
NA2O	0.0	0.0	0.0	******	0.0	0.0	0.0	******	******	0.0
CAO	0.0	0.0	0.0	0.0	0.28	0.0	0.0	0.0	0.01	0.01
FEO	24.41	21.15	16.32	20.29	25.52	20.37	12.96	21.04	22.89	23.71
MGO	5.75	7.69	15.12	9.45	7.12	9.47	13.21	8.60	7.93	6.21
TOTAL	99.34	98.96	103.56	99.38	101.25	100.23	100.03	97.65	98.34	102.30

NUMBER CATIONS / 4 OXYGENS

CR	1.282	1.440	0.362	1.182	0.638	1.102	1.529	1.124	0.882	1.071
AL	0.503	0.415	1.473	0.700	1.110	0.788	0.399	0.722	0.874	0.669
FE3	0.211	0.138	0.151	0.112	0.242	0.105	0.070	0.148	0.239	0.256
SI	0.003	0.006	0.003	0.005	0.007	0.004	0.002	0.004	0.004	0.004
TI	0.008	0.006	0.004	******	0.006	0.009	0.006	******	******	0.035
NI	0.002	0.002	0.001	******	0.001	0.001	0.004	******	******	0.0
NA	0.0	0.0	0.0	******	0.0	0.0	0.0	******	******	0.0
CA	0.000	0.000	0.0	0.000	0.009	0.000	0.000	0.000	0.001	0.001
FE2	0.691	0.598	0.382	0.546	0.652	0.537	0.349	0.578	0.618	0.633
MG	0.291	0.388	0.609	0.454	0.325	0.445	0.635	0.422	0.382	0.296

MOLAR RATIOS

CR/(CR+AL+FE3)	0.642	0.723	0.181	0.593	0.321	0.553	0.766	0.564	0.442	0.537
MG/(MG+FE2)	0.296	0.394	0.614	0.454	0.332	0.453	0.645	0.422	0.382	0.319
CR/FE	1.4	2.0	0.7	1.8	0.7	1.7	3.7	1.5	1.0	1.2

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 53.76 SD: 4.35

HIGH AL MEAN: 33.69 SD: 7.70

****** NOT ANALYZED

MICROPROBE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	211	212	213	214	215	216	217	218	219	220
CR2O3	53.76	41.57	44.55	50.34	54.15	54.01	47.72	46.55	49.07	39.75
AL2O3	10.72	15.62	18.11	16.32	10.45	13.98	16.57	16.08	11.56	24.62
FE2O3	4.53	11.29	7.39	3.83	5.11	3.53	5.36	6.96	8.85	4.92
SIO2	0.14	0.16	0.22	0.07	0.16	0.06	0.22	0.10	0.13	0.17
TIO2	0.25	******	******	0.31	******	0.22	0.25	0.29	0.31	******
NIO	0.10	******	******	0.0	******	0.08	0.07	0.04	0.01	******
NA2O	0.0	******	******	0.0	******	0.0	0.0	0.0	0.0	******
CAO	0.0	0.01	0.01	0.0	0.02	0.0	0.01	0.0	0.0	0.28
MNO	******	******	******	******	******	******	0.18	******	******	******
FEO	21.51	25.27	23.31	20.36	21.61	18.10	21.51	21.22	22.82	21.31
MGO	7.31	5.93	7.87	9.05	7.71	10.36	8.16	8.26	6.75	9.43
TOTAL	98.32	99.85	101.56	100.28	99.21	100.44	100.05	99.50	99.50	100.48

NUMBER CATIONS / 4 OXYGENS

CR	1.447	1.095	1.129	1.283	1.446	1.377	1.225	1.204	1.309	0.976
AL	0.430	0.614	0.683	0.620	0.416	0.532	0.634	0.620	0.460	0.901
FE3	0.116	0.283	0.178	0.093	0.130	0.038	0.131	0.171	0.225	0.115
SI	0.005	0.006	0.007	0.003	0.006	0.002	0.007	0.004	0.005	0.006
TI	0.007	******	******	0.008	******	0.005	0.006	0.007	0.008	******
NI	0.003	******	******	0.0	******	0.002	0.002	0.001	0.001	******
NA	0.0	******	******	0.0	******	0.0	0.0	0.0	0.0	******
CA	0.0	0.001	0.001	0.000	0.001	0.0	0.001	0.000	0.0	0.010
MN	******	******	******	******	******	******	0.005	******	******	******
FE2	0.612	0.704	0.624	0.549	0.610	0.488	0.584	0.580	0.644	0.553
MG	0.371	0.295	0.376	0.435	0.389	0.493	0.395	0.403	0.339	0.437

MOLAR RATIOS

CR/(CR+AL+FE3)	0.725	0.550	0.557	0.643	0.726	0.690	0.615	0.603	0.657	0.490
MG/(MG+FE2)	0.377	0.295	0.376	0.442	0.389	0.505	0.404	0.410	0.345	0.441
CR/FE	2.0	1.1	1.4	2.0	2.0	2.4	1.7	1.6	1.5	1.5

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 53.47 SD: 4.41

HIGH AL MEAN: 33.80 SD: 7.69

****** NOT ANALYZED

MICROPROBE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	221	222	223	224	225	226	227	228	229	230
CR2O3	45.67	51.43	50.86	57.18	45.11	54.33	57.53	56.61	49.75	54.27
AL2O3	14.78	12.78	12.93	11.03	19.02	12.10	10.11	11.22	12.71	12.01
FE2O3	9.38	5.56	6.42	2.98	5.99	3.84	2.49	2.43	7.43	4.93
SIO2	0.21	0.19	0.11	0.06	0.12	0.08	0.03	0.16	0.12	0.03
TIO2	******	******	0.31	0.22	0.42	0.19	0.29	0.19	0.21	0.20
NIO	******	******	0.11	0.04	0.04	0.04	0.08	0.0	0.05	0.04
NA2O	******	******	******	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAO	0.0	0.01	0.01	0.0	0.0	0.0	0.0	0.0	0.03	0.01
FEO	24.05	20.99	21.19	15.68	19.96	18.45	17.40	14.89	22.32	17.23
MGO	5.92	8.39	7.98	11.25	9.39	9.51	9.78	11.58	7.34	10.48
TOTAL	101.01	99.35	99.92	98.44	100.05	98.54	97.71	97.08	99.96	99.20

NUMBER CATIONS / 4 OXYGENS

CR	1.186	1.351	1.330	1.493	1.136	1.426	1.533	1.491	1.309	1.411
AL	0.572	0.501	0.504	0.430	0.714	0.474	0.402	0.441	0.499	0.466
FE3	0.232	0.139	0.160	0.074	0.144	0.096	0.063	0.061	0.186	0.122
SI	0.007	0.007	0.004	0.002	0.004	0.003	0.001	0.006	0.004	0.001
TI	******	******	0.008	0.006	0.010	0.005	0.008	0.005	0.006	0.005
NI	******	******	0.003	0.001	0.001	0.001	0.002	0.0	0.002	0.001
NA	******	******	******	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CA	0.000	0.001	0.001	0.0	0.0	0.000	0.0	0.0	0.001	0.001
FE2	0.660	0.583	0.586	0.433	0.532	0.512	0.491	0.415	0.621	0.474
MG	0.339	0.416	0.394	0.554	0.446	0.476	0.492	0.575	0.365	0.514

MOLAR RATIOS

CR/(CR+AL+FE3)	0.596	0.679	0.667	0.748	0.570	0.714	0.767	0.748	0.656	0.706
MG/(MG+FE2)	0.339	0.416	0.402	0.561	0.456	0.482	0.501	0.581	0.370	0.520
CR/FE	1.3	1.9	1.8	2.9	1.7	2.3	2.8	3.1	1.6	2.4

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 53.36 SD: 4.41

HIGH AL MEAN: 33.80 SD: 7.69

****** NOT ANALYZED

MICROPROBE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	231	232	233	234	235	236	237	238	239	240
CR2O3	50.66	54.96	54.04	56.27	49.54	33.70	9.96	56.00	54.00	57.94
AL2O3	12.45	11.73	11.11	11.45	12.75	29.79	60.18	12.04	11.85	11.37
FE2O3	5.26	4.21	4.75	3.83	7.25	7.36	1.33	3.16	4.85	2.35
SIO2	0.13	0.08	0.16	0.13	0.14	0.11	0.20	0.0	0.12	0.13
TIO2	0.0	0.22	0.0	0.23	0.29	0.65	0.33	0.18	0.18	0.22
NIO	0.06	0.05	0.08	0.03	0.12	0.13	0.0	0.06	0.02	0.02
NA2O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAO	0.0	0.0	0.01	0.0	0.0	0.0	0.09	0.0	0.04	0.0
ZNO	******	******	******	0.09	******	******	******	******	******	******
FEO	21.15	15.64	19.45	15.05	21.61	19.36	12.45	14.35	17.84	13.91
MGO	8.09	11.27	9.02	11.71	7.57	11.01	19.46	12.13	10.03	12.46
TOTAL	98.80	98.16	98.62	98.79	99.27	102.11	104.00	97.92	98.93	98.40

NUMBER CATIONS / 4 OXYGENS

CR	1.343	1.435	1.433	1.457	1.309	0.790	0.197	1.455	1.411	1.498
AL	0.492	0.457	0.439	0.442	0.502	1.041	1.771	0.467	0.462	0.438
FE3	0.158	0.105	0.120	0.095	0.182	0.154	0.025	0.078	0.121	0.058
SI	0.005	0.003	0.006	0.005	0.005	0.004	0.005	0.000	0.004	0.005
TI	0.0	0.006	0.0	0.006	0.008	0.015	0.006	0.005	0.005	0.006
NI	0.002	0.002	0.002	0.001	0.003	0.003	0.0	0.002	0.001	0.001
NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CA	0.0	0.0	0.001	0.000	0.0	0.000	0.003	0.0	0.002	0.0
ZN	******	******	******	0.002	******	******	******	******	******	******
FE2	0.593	0.432	0.546	0.412	0.604	0.480	0.260	0.394	0.493	0.380
MG	0.405	0.555	0.451	0.572	0.378	0.487	0.725	0.594	0.495	0.608

MOLAR RATIOS

CR/(CR+AL+FE3)	0.674	0.719	0.719	0.731	0.657	0.396	0.099	0.728	0.708	0.751
MG/(MG+FE2)	0.406	0.562	0.453	0.581	0.385	0.504	0.736	0.601	0.501	0.615
CR/FE	1.8	2.7	2.2	2.9	1.7	1.2	0.7	3.1	2.3	3.4

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 53.42 SD: 4.32

HIGH AL MEAN: 33.60 SD: 7.93

****** NOT ANALYZED

MICROPROBE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	241	242	243	244	245	246	247	248	249	250
CR2O3	43.32	43.96	42.28	58.19	28.38	56.43	51.34	57.20	46.79	55.93
AL2O3	16.84	17.69	24.07	11.98	35.18	10.73	14.53	10.54	17.06	11.82
FE2O3	8.55	7.62	3.37	1.97	4.72	3.33	4.73	2.49	5.95	2.40
SIO2	0.13	0.16	0.16	0.0	0.32	0.09	0.08	0.13	0.0	0.04
TIO2	0.0	0.47	0.0	0.0	0.01	0.25	0.43	0.19	0.01	0.10
NIO	0.08	0.04	0.07	0.12	0.0	0.10	0.20	0.0	0.11	0.01
NA2O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAO	0.0	0.0	0.06	0.0	0.12	0.0	0.0	0.0	0.0	0.0
FEO	23.61	22.11	17.46	13.02	22.28	17.25	20.30	14.44	19.43	18.47
MGO	7.05	7.73	11.75	13.28	10.16	10.09	8.65	11.72	9.67	9.66
TOTAL	99.58	99.78	99.22	98.56	101.17	98.27	100.26	96.71	99.02	98.43

NUMBER CATIONS / 4 OXYGENS

CR	1.128	1.129	1.035	1.493	0.661	1.490	1.322	1.515	1.201	1.473
AL	0.654	0.677	0.879	0.459	1.222	0.422	0.558	0.415	0.653	0.464
FE3	0.212	0.186	0.079	0.048	0.105	0.084	0.116	0.063	0.145	0.060
SI	0.005	0.006	0.005	0.0	0.009	0.003	0.003	0.005	0.000	0.001
TI	0.000	0.012	0.000	0.000	0.000	0.006	0.011	0.005	0.000	0.003
NI	0.002	0.001	0.002	0.003	0.0	0.003	0.005	0.0	0.003	0.000
NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CA	0.000	0.0	0.002	0.0	0.004	0.0	0.0	0.0	0.0	0.0
FE2	0.650	0.601	0.452	0.353	0.549	0.482	0.553	0.404	0.528	0.515
MG	0.346	0.375	0.543	0.643	0.446	0.503	0.420	0.585	0.468	0.480

MOLAR RATIOS

CR/(CR+AL+FE3)	0.566	0.567	0.520	0.747	0.333	0.746	0.662	0.760	0.601	0.737
MG/(MG+FE2)	0.348	0.384	0.545	0.645	0.448	0.510	0.432	0.591	0.470	0.483
CR/FE	1.3	1.4	1.9	3.7	1.0	2.6	2.0	3.2	1.8	2.6

MEAN AND VARIANCE OF PERCENT. CR2O3

HIGH CR MEAN: 53.46 SD: 4.31

HIGH AL MEAN: 33.79 SD: 7.95

****** NOT ANALYZED

MICROPROBE ANALYSES OF CHROMITE FROM ALPINE ULTRAMAFIC COMPLEXES

OXIDE WEIGHT PERCENT

	251	252	253	254
CR203	48.04	41.78	42.54	42.67
AL203	19.10	24.86	26.37	25.83
FE203	3.54	3.98	2.38	3.54
SI02	0.14	0.06	0.0	0.0
TI02	0.26	0.16	0.16	0.36
NIO	0.06	0.05	0.30	0.08
NA20	0.0	0.0	0.0	0.0
CAO	0.01	0.0	0.13	0.0
FEO	21.52	18.73	10.68	14.66
MGO	8.47	11.24	15.88	13.77
TOTAL	100.14	100.86	98.44	100.91

NUMBER CATIONS / 4 OXYGENS

CR	1.222	1.010	1.011	1.009
AL	0.686	0.896	0.935	0.911
FE3	0.086	0.092	0.054	0.080
SI	0.005	0.002	0.0	0.0
TI	0.006	0.004	0.004	0.008
NI	0.002	0.001	0.007	0.002
NA	0.0	0.0	0.0	0.0
CA	0.000	0.0	0.005	0.0
FE2	0.579	0.479	0.259	0.367
MG	0.406	0.512	0.712	0.614

MOLAR RATIOS

CR/(CR+AL+FE3)	0.613	0.506	0.506	0.505
MG/(MG+FE2)	0.412	0.517	0.726	0.626
CR/FE	1.8	1.8	3.1	2.3

MEAN AND VARIANCE OF PERCENT. CR203

HIGH CR MEAN: 53.42 SD: 4.32

HIGH AL MEAN: 34.00 SD: 7.97

****** NOT ANALYZED

Table 2

U. S. GOVERNMENT PRINTING OFFICE : 1972 O - 457-064
867-1

Analyses of olivine from alpine ultramafic complexes
Oxide Weight percent
Sample No. corresponds to analysis of associated chromite in Table 1

Sample No.	(7)	(14)	(23)	(27)	(33)	(37)	(51)	(52)	(53)	(55)	(64)	(68)
Cr_2O_3	0.44	0.17	0.13	0.11	0.02	0.27	0.16	0.12	0.07	0.08	0.49	0.55
Al_2O_3	.00	.06	.00	.00	.0	.36	.00	.22	.00	.00	.00	.0
V_2O_3	--	--	--	--	--	--	.00	.00	--	--	--	--
SiO_2	41.26	41.56	40.29	40.98	42.39	40.38	40.58	39.25	40.96	42.96	39.86	42.07
TiO_2	.00	.00	.00	--	--	--	.03	.00	.00	--	.01	--
NiO	.81	.49	.40	--	--	--	0.04	--	.39	--	.40	--
Na_2O	--	.00	--	--	--	--	.00	.01	.00	--	.00	--
CaO	.00	.00	.00	.10	.07	.03	.04	.00	.00	--	.00	.00
ZnO	.00	--	--	--	--	--	--	--	--	--	.02	--
FeO	3.26	3.93	6.45	7.96	5.92	6.49	7.44	7.70	7.84	6.64	6.36	3.60
MgO	55.24	54.95	52.11	52.29	53.75	52.84	51.61	51.54	52.42	52.11	53.02	55.75
Total	101.01	101.16	99.44	101.44	102.15	100.37	99.90	98.83	101.68	101.81	100.16	101.97

Number cations / 4 oxygens

Cr	0.008	0.003	0.002	0.002	0.000	0.006	0.003	0.002	0.001	0.001	0.009	0.010
Al	.00	.002	.00	.00	.0	.010	.00	.006	.00	.00	.00	.00
V	--	--	--	--	--	--	.00	.00	--	--	--	--
Si	.978	.984	.982	.983	.998	.974	.986	.968	.981	1.015	.966	.985
Ti	.0	.00	.000	--	--	--	.001	.00	.00	--	.000	--
Ni	.015	.009	.008	--	--	--	--	--	--	--	.008	--
Na	--	.00	--	--	--	--	.002	.000	.008	.001	.00	--
Ca	.00	.00	.002	.003	.002	.001	.001	.00	.00	--	--	.0
Zn	.00	--	.00	--	--	--	--	--	--	--	--	--
Fe	.065	.078	.132	.160	.116	.131	.151	.159	.157	.131	.129	.070
Mg	1.952	1.939	1.893	1.869	1.886	1.900	1.869	1.894	1.871	1.836	1.916	1.945

-- Not analyzed

	(71)	(72)	(73)	(74)	(75)	(76)	(77)	(78)	(79)	(81)	(83)
Cr_2O_3	0.39	0.0	0.34	0.0	0.79	0.67	0.76	0.12	0.21	0.06	0.0
Al_2O_3	0.03	0.05	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.08
SiO_2	41.40	41.61	41.66	42.37	39.99	42.42	41.07	42.51	42.11	41.06	41.69
TiO_2	0.0	0.00	0.02	0.0	0.0	0.03	0.01	0.03	0.0	0.02	0.0
CaO	0.0	0.0	0.0	0.03	0.03	0.0	0.0	0.0	0.0	0.0	0.0
NiO	0.60	0.25	0.44	0.50	0.43	0.69	0.50	0.54	0.52	0.67	0.47
Na_2O	.00	.00	.00	.00	--	.00	--	.00	.00	.00	.00
FeO	3.65	6.62	5.04	6.70	4.69	3.45	5.07	4.81	6.01	4.71	4.70
MgO	55.80	53.35	54.44	53.12	54.17	55.23	54.18	53.79	53.59	54.37	54.56
Total	101.87	101.88	101.94	102.72	100.10	102.49	101.59	101.80	102.44	100.89	101.50

Number Cations / 4 oxygen

Cr	0.007	0.0	0.006	0.0	0.015	0.012	0.014	0.002	0.004	0.001	0.0
Al	0.001	0.001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.002
Si	0.974	0.987	0.983	0.997	0.964	0.990	0.975	1.001	0.992	0.979	0.986
Ti	0.0	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.0	0.000	0.0
Ca	0.0	0.0	0.0	0.001	0.001	0.0	0.0	0.0	0.0	0.0	0.0
Ni	0.011	0.005	0.008	0.010	0.008	0.013	0.010	0.010	0.010	0.013	0.009
Na	.00	.00	.00	.00	--	.00	--	.00	.00	.00	.00
Fe	0.072	0.131	0.099	0.132	0.095	0.067	0.101	0.095	0.118	0.094	0.093
Mg	1.957	1.887	1.916	1.863	1.946	1.921	1.918	1.888	1.882	1.933	1.923

-- Not analyzed

Oxide Weight percent

	(84)	(85)	(86)	(87)	(90)	(91)	(92)	(93)	(94)
Cr_2O_3	0.05	0.21	0.09	0.23	1.11	0.58	0.00	0.0	0.01
Al_2O_3	0.0	0.0	0.07	0.0	0.0	0.0	0.0	0.0	0.31
SiO_2	40.72	40.96	39.91	41.41	42.02	41.85	41.88	41.08	40.77
TiO_2	0.0	0.01	0.00	0.01	0.0	0.0	0.0	0.0	0.03
CaO	0.05	0.03	0.0	0.04	0.02	0.02	0.03	0.02	0.0
NiO	0.70	0.62	0.22	0.45	0.32	0.32	0.23	0.30	0.35
Na_2O	.00	.00	.00	--	.00	.00	.00	.00	.00
FeO	6.92	5.85	5.57	4.28	2.87	2.76	5.21	7.86	4.76
MgO	52.45	53.58	54.08	55.08	54.98	55.95	54.32	50.98	54.00
Total	100.89	101.25	99.94	101.50	101.32	101.48	101.67	100.24	100.23

Number cations / 4 oxygens

Cr	0.001	0.004	0.002	0.004	0.021	0.011	0.000	0.0	0.000
Al	0.0	0.0	0.002	0.0	0.0	0.0	0.0	0.0	0.009
Si	0.981	0.978	0.964	0.979	0.989	0.983	0.989	0.996	0.977
Ti	0.0	0.000	0.000	0.000	0.0	0.0	0.0	0.0	0.000
Ca	0.001	0.001	0.0	0.001	0.000	0.000	0.001	.00	.00
Ni	0.014	0.012	0.004	0.009	0.006	0.006	0.004	0.006	0.007
Na	.00	.00	.00	--	.00	.00	.00	.00	.00
Fe	0.139	0.117	0.113	0.085	0.056	0.054	0.103	0.159	0.095
Mg	1.883	1.908	1.948	1.941	1.982	1.958	1.913	0.842	0.929

-- Not analyzed

Oxide Weight percent

	(98)	(100)	(105)	(106)	(108)	(111)	(118)
Cr_2O_3	0.36	0.10	1.02	0.13	0.03	0.15	0.69
Al_2O_3	.00	.00	.00	.00	.00	.00	.00
V_2O_3	--	--	--	--	--	--	--
SiO_2	41.14	41.01	41.98	41.92	41.75	42.12	40.82
TiO_2	.00	.05	.0	.01	.04	--	--
NiO	.39	.46	.50	.48	.31	--	--
Na_2O	.00	.00	.00	.00	.00	--	--
CaO	.000	.00	.00	.00	.00	.00	.02
FeO	4.75	4.73	3.59	5.21	6.82	4.96	3.75
MgO	54.80	53.65	54.88	54.07	52.99	51.13	54.27
Total	101.44	100.00	101.97	101.91	101.95	98.37	100.03

Number cations / 4 oxygens

Cr	0.007	0.002	0.019	0.003	0.001	0.003	0.013
Al	.00	.00	.00	.00	.00	.00	.00
V	--	--	--	--	--	--	--
Si	.976	.985	.986	.989	.991	1.022	.978
Ti	.00	.001	.00	.000	.001	--	--
Ni	.007	.009	.009	.009	.006	--	--
Na	.0	.0	.0	.0	.0	--	--
Ca	.0	.00	.00	.00	.0	.0	.00
Fe	.094	.095	.070	.103	.135	.101	.075
Mg	1.937	1.921	1.921	1.903	1.875	1.850	1.839

-- Not analyzed

Oxide Weight percent

	(130)	(124)	(151)	(142)	(145)	(166)	(167)	(168)	(170)	(177)	(178)	(180)
Cr_2O_3	0.0	0.0	0.08	0.05	.02	0.0	0.04	.17	0.17	.01	0.0	1.00
Al_2O_3	0.0	.0	.0	.01	.00	0.0	0.0	.00	.0	.01	0.0	.1
SiO_2	42.40	41.38	42.11	41.36	40.59	40.54	40.33	41.18	40.68	39.54	0.96	41.49
TiO_2	0.0	.0	.0	.0	.02	.0	.0	.00	.02	--	--	--
CaO	0.10	.0	.04	.0	.0	.0	.06	.04	.05	.08	.0	.0
NiO	.20	.28	.28	.27	.27	.41	.20	.39	.41	--	--	--
Na_2O	.0	.0	.0	.0	.0	.0	--	--	--	--	--	--
FeO	12.91	8.31	6.50	7.66	6.96	9.77	8.56	7.16	6.78	14.10	7.77	4.55
MgO	47.37	51.13	52.80	52.32	51.92	50.55	51.27	52.57	52.57	46.92	52.23	54.58
Total	102.98	101.10	101.81	101.67	99.78	101.27	100.46	101.51	100.68	100.66	100.96	101.62

Number cations / 4 oxygens

Cr	0.0	0.0	0.001	0.001	0.000	0.0	0.001	0.003	0.003	0.000	0.0	0.019
Al	0.0	0.0	.0	.000	.0	.0	.0	.0	.0	.000	.0	.0
Si	1.019	.996	.998	.988	.986	.977	.981	.985	.980	.983	.985	.980
Ti	.0	.0	.0	.0	.000	.0	.0	.0	.0	--	--	--
Ca	.003	.0	.001	.0	.0	.0	.002	.002	.001	.002	.0	.0
Ni	.004	.005	.005	.005	.006	.008	.004	.008	.008	--	--	--
Na	.0	.0	.0	.0	.0	.0	--	--	--	--	--	--
Fe	.259	.167	.129	.153	.141	.223	.174	.143	.137	.293	.156	.090
Mg	1.697	1.835	1.866	1.863	1.881	1.815	1.858	1.874	1.888	1.738	1.873	1.922

	(181) At	(181)	(183)	(184)	(185)	(186)	(188)	(190)	(191)	(192)
Cr_2O_3	0.01	0.01	0.0	0.01	0.27	0.07	0.04	0.08	0.04	0.13
Al_2O_3	0.0	0.0	0.09	0.0	0.0	0.01	0.0	0.0	0.0	0.0
SiO_2	41.42	41.23	40.30	41.34	42.79	39.42	40.90	42.05	41.27	41.74
TiO_2	0.01	0.0	0.0	0.0	0.05	0.02	0.01	0.01	0.03	0.01
NiO	0.23	0.20	0.15	0.42	0.54	0.09	0.34	0.42	0.32	0.45
Na_2O	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
CaO	0.04	0.23	0.06	0.03	0.05	0.19	0.07	0.02	0.02	0.02
FeO	8.38	9.63	13.16	5.82	3.74	17.28	10.68	3.43	9.64	3.24
MgO	51.88	50.33	47.87	53.45	54.60	45.26	49.73	55.98	51.28	55.66
Total	101.97	101.63	101.63	101.07	102.04	102.34	101.77	101.99	102.60	101.25
					Number cations / 4 oxygens					
Cr	0.000	0.000	0.0	0.000	0.005	0.001	0.001	0.001	0.001	0.002
Al	0.0	0.0	0.003	0.0	0.0	0.000	0.0	0.0	0.0	0.0
Si	0.990	0.994	0.987	0.986	1.001	0.978	0.990	0.984	0.986	0.984
Ti	0.000	0.0	0.0	0.0	0.001	0.000	0.000	0.000	0.000	0.000
Ni	0.004	0.004	0.003	0.008	0.010	0.002	0.007	0.008	0.006	0.009
Ca	0.001	0.006	0.002	0.001	0.001	0.005	0.002	0.000	0.000	0.000
Fe	0.167	0.194	0.270	0.116	0.073	0.359	0.216	0.067	0.193	0.064
Mg	1.847	1.808	1.748	1.901	1.904	1.674	1.794	1.953	1.827	1.956

-- Not analyzed

	(193)	(194)	(195)	(197)	(198)	(199)	(200)	(201)	(202)	(203)
Cr_2O_3	0.54	0.11	0.18	0.60	0.46	0.04	0.13	0.0	0.09	0.08
Al_2O_3	0.0	0.0	0.0	0.0	0.0	0.02	0.0	0.0	0.0	0.08
SiO_2	41.49	40.84	42.02	42.06	42.42	41.18	41.83	41.36	42.37	41.12
TiO_2	0.0	0.03	0.03	0.03	0.03	0.0	0.0	0.02	0.02	0.02
NiO	0.86	0.44	0.68	0.52	0.52	0.26	0.46	0.20	0.32	0.14
Na_2O	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
CaO	0.01	0.02	0.03	0.03	0.0	0.01	0.0	0.01	0.03	0.03
FeO	2.78	7.50	3.67	2.48	2.23	9.06	5.73	9.49	6.70	9.40
MgO	56.29	52.80	55.86	55.98	56.15	51.78	53.64	50.99	52.79	50.92
Total	101.95	101.74	102.47	101.70	101.81	102.35	101.79	102.07	102.32	101.87
					Number cations / 4 oxygens					
Cr	0.010	0.002	0.003	0.011	0.008	0.001	0.002	0.0	0.001	0.001
Al	0.0	0.0	0.0	0.0	0.0	0.001	0.0	0.0	0.0	0.0
Si	0.973	0.977	0.982	0.985	0.990	0.984	0.990	0.992	1.000	1.012
Ti	0.0	0.001	0.001	0.001	0.001	0.0	0.0	0.000	0.000	0.0
Ni	0.016	0.008	0.013	0.010	0.010	0.005	0.009	0.004	0.006	0.002
Ca	0.000	0.001	0.001	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fe	0.054	0.150	0.072	0.049	0.043	0.181	0.114	0.190	0.132	0.209
Mg	1.968	1.883	1.945	1.954	1.953	1.844	1.893	1.822	1.857	1.764

-- Not analyzed

Oxide Weight percent

	(204)	(205)	(206)	(207)	(208)	(209)	(210)	(211)	(212)	(213)
Cr_2O_3	0.00	0.0	0.01	0.26	0.02	0.12	0.0	0.08	0.0	0.0
Al_2O_3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SiO_2	40.67	40.40	40.83	42.43	40.10	40.30	40.14	41.88	40.60	40.38
TiO_2	--	0.03	0.01	0.0	--	--	0.0	0.0	--	--
NiO	--	0.11	0.19	0.54	--	--	0.0	0.35	--	--
Na_2O	--	.00	.00	.00	--	--	.00	.00	--	--
CaO	0.02	0.23	0.04	0.01	0.03	0.02	0.01	0.0	0.0	0.02
FeO	7.75	14.12	8.86	2.39	8.21	10.47	10.80	6.13	10.14	8.37
MgO	52.07	47.44	51.67	56.88	51.24	49.29	50.39	53.27	50.43	50.93
Total	100.51	102.33	101.61	102.51	99.60	100.20	101.34	101.71	101.17	101.17

Number cations / 4 oxygens

Cr	0.00	0.0	0.000	0.005	0.000	0.002	0.0	0.002	0.0	0.0
Al	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Si	0.983	0.987	0.982	0.984	0.981	0.989	0.976	0.993	0.985	0.987
Ti	--	0.000	0.000	0.0	--	--	0.0	0.0	--	--
Ni	--	0.002	0.004	0.010	--	--	0.0	0.007	--	--
Na	--	.00	.00	.00	--	--	.00	.00	--	--
Ca	0.001	0.006	0.001	0.000	0.001	0.001	0.000	0.0	0.0	0.001
Fe	0.157	0.289	0.178	0.046	0.168	0.215	0.220	0.122	0.206	0.171
Mg	1.876	1.728	1.852	1.967	1.869	1.803	1.827	1.883	1.824	1.855

-- Not analyzed

Oxide Weight percent

	(214)	(215)	(216)	(217)	(218)	(219)	(220)	(221)	(222)	(223)
Cr_2O_3	0.07	0.0	0.03	0.21	0.0	0.09	0.0	0.0	0.0	0.19
Al_2O_3	0.02	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SiO_2	41.73	41.55	40.64	41.35	41.39	41.64	40.32	40.43	40.52	40.68
TiO_2	0.000	--	0.06	0.0	0.04	0.0	--	--	--	0.0
NiO	0.38	--	0.47	0.27	0.40	0.18	--	--	--	0.26
Na_2O	.00	--	.00	.00	.00	.00	.00	--	--	.00
CaO	0.0	0.0	0.04	0.01	0.01	0.0	0.17	0.00	0.01	0.02
FeO	6.44	6.56	5.92	7.95	8.08	8.08	9.31	9.45	6.93	6.72
MgO	53.78	52.99	53.98	51.78	52.15	52.84	51.01	50.87	52.59	53.35
Total	102.42	101.10	101.16	101.57	101.97	102.83	100.81	100.84	100.05	101.22

Number cations / 4 oxygens

Cr	0.001	0.0	0.001	0.004	0.0	0.002	0.0	0.0	0.0	0.004
Al	0.001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Si	0.985	0.992	0.972	0.990	0.988	0.985	0.980	0.982	0.981	0.975
Ti	0.000	--	0.001	0.0	0.001	0.0	--	--	--	0.0
Ni	0.007	--	0.009	0.005	0.006	0.003	--	--	--	0.005
Na	.00	--	.00	.00	.00	.00	--	--	--	.00
Ca	0.0	0.0	0.001	0.000	0.000	0.0	0.004	0.000	0.000	0.000
Fe	0.127	0.131	0.118	0.159	0.161	0.160	0.189	0.194	0.140	0.135
Mg	0.893	1.886	1.924	1.848	1.855	1.864	1.847	1.842	1.898	1.905

-- Not analyzed

Oxide Weight Percent

	(224)	(225)	(226)	(227)	(228)	(229)	(230)	(231)	(232)	(233)
Cr_2O_3	0.07	0.03	0.13	0.02	0.24	0.18	0.05	0.28	0.0	0.53
Al_2O_3	0.0	.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SiO_2	42.19	40.79	41.78	42.14	41.56	41.96	42.08	42.26	41.35	41.48
TiO_2	0.0	.00	0.0	0.01	0.0	0.02	0.02	0.05	0.0	0.03
NiO	0.41	.23	0.34	0.40	0.20	--	0.30	0.39	0.40	0.59
Na_2O	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
CaO	0.0	.03	0.0	0.0	0.01	0.03	0.02	0.02	0.01	0.00
FeO	3.93	7.20	7.57	5.46	4.06	3.25	7.64	4.24	6.89	3.94
MgO	55.38	53.31	52.64	54.44	54.21	54.75	52.11	54.75	52.31	54.97
Total	101.98	101.59	102.46	102.47	100.28	100.19	102.22	101.99	100.96	101.54
					Number cations / 4 oxygens					
Cr	0.001	0.001	0.002	0.000	0.005	0.003	0.001	0.005	0.0	0.010
Al	0.0	.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Si	0.989	.975	0.990	0.989	0.991	0.996	0.998	0.992	0.992	0.980
Ti	0.0	.0	0.0	0.000	0.0	0.000	0.000	0.001	0.0	0.001
Ni	0.008	.004	0.006	0.008	0.004	--	0.006	0.007	0.008	0.011
Na	.00	.00	.00	.00	.00	--	.00	.00	.00	.00
Ca	0.0	.001	0.0	0.0	0.000	0.001	0.000	0.001	0.000	0.000
Fe	0.077	.144	0.150	0.107	0.081	0.064	0.152	0.083	0.138	0.078
Mg	1.935	1.900	1.860	1.906	1.926	1.937	1.843	1.916	1.870	1.935

-- Not analyzed

Oxide Weight Percent

	(234)	(235)	(236)	(237)	(238)	(239)	(240)	(241)	(242)	(243)
Cr_2O_3	0.01	0.23	0.0	0.0	0.0	0.0	0.22	0.0	0.07	0.0
Al_2O_3	0.01	0.0	0.0	0.0	0.01	0.0	0.02	0.0	0.03	0.0
SiO_2	42.19	42.81	41.52	40.35	40.63	42.40	42.51	43.05	40.45	41.54
TiO_2	0.06	0.07	0.01	0.04	0.05	0.0	0.02	0.02	0.03	0.06
NiO	0.32	0.38	0.39	0.30	0.32	0.51	0.34	0.54	0.24	0.21
Na_2O	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
CaO	0.04	0.05	0.04	0.01	0.06	0.0	0.03	0.0	0.03	0.0
FeO	5.73	3.50	6.82	8.99	9.55	3.25	4.45	3.19	9.22	9.21
MgO	52.30	54.69	52.59	50.99	49.82	55.71	54.32	54.92	51.13	50.30
Total	101.67	101.73	101.37	100.68	100.44	102.17	101.91	101.72	101.17	101.32
					Number cations / 4 oxygens					
Cr	0.000	0.004	0.0	0.0	0.0	0.006	0.004	0.0	0.001	0.0
Al	0.000	0.0	0.0	0.0	0.000	0.0	0.001	0.0	0.0	0.0
Si	0.998	1.002	0.991	0.981	0.991	0.990	0.998	1.006	0.980	1.001
Ti	0.001	0.001	0.008	0.006	0.006	0.0	0.000	0.000	0.000	0.001
Ni	0.006	0.007	0.001	0.000	0.002	0.010	0.006	0.010	0.005	0.004
Na	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Ca	0.001	0.001	0.001	0.000	0.002	0.0	0.001	0.0	0.001	0.0
Fe	0.113	0.069	0.136	0.183	0.195	0.063	0.087	0.062	0.187	0.186
Mg	1.880	1.909	1.872	1.848	1.812	1.939	1.902	1.914	1.846	1.807

-- Not analyzed

	Oxide Weight Percent						
	(244)	(246)	(247)	(248)	(250)	(251)	(252)
Cr_2O_3	0.04	0.04	0.24	0.03	0.46	0.06	0.16
Al_2O_3	0.0	0.0	.00	0.0	0.0	0.0	0.0
SiO_2	41.36	39.93	41.56	41.72	40.94	41.36	41.12
TiO_2	0.06	0.09	.00	0.03	0.0	0.0	0.0
NiO	0.03	0.01	.20	0.59	0.47	0.31	0.24
Na_2O	.00	.00	.00	.00	.00	.00	.00
CaO	0.11	0.21	.01	0.02	0.0	0.02	0.05
FeO	6.61	11.11	4.06	4.25	3.76	7.07	7.94
MgO	52.50	49.87	54.21	54.34	54.21	52.66	51.60
Total	100.80	101.16	100.28	100.98	99.84	101.48	101.11
	Number cations/4 oxygens						
Cr	0.001	0.001	0.005	0.001	0.009	0.001	0.003
Al	0.0	0.0	.0	0.0	0.0	0.0	0.0
Si	0.992	0.974	.991	--	--	--	--
Ti	0.000	0.002	.00	0.990	0.982	0.988	0.989
Ni	0.001	0.000	.005	0.001	0.0	0.0	0.0
Na	.00	.00	.00	.00	.00	.00	.00
Ca	0.003	0.006	.000	0.001	0.0	0.001	0.001
Fe	0.133	0.227	.081	0.084	0.075	0.141	0.160
Mg	1.876	1.814	1.926	1.922	1.938	1.875	1.851

Appendix

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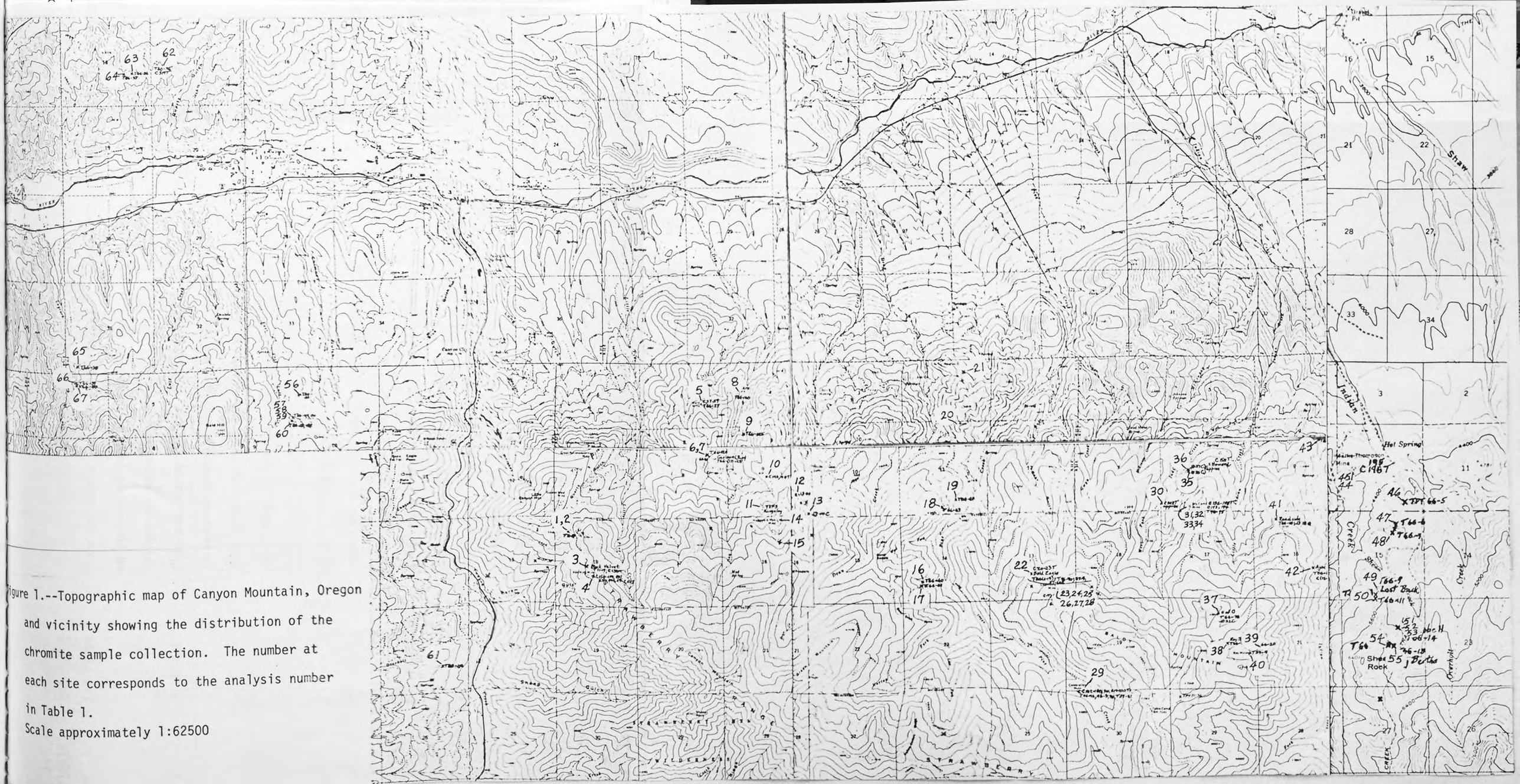


Figure 1.--Topographic map of Canyon Mountain, Oregon and vicinity showing the distribution of the chromite sample collection. The number at each site corresponds to the analysis number in Table 1.
Scale approximately 1:62500

Locations and descriptions of chromite samples listed in table 1.

No. of Analysis	Field sample No.	Sample description	Location	UTM Coordinate E	UTM Coordinate N
1	TPT 71-8A	Fine and coarse grained chromite in serpentinized dunite. Chromite has fringes of magnetite.	Canyon Mt., Oregon, U.S.A.	346380	4913580
2	TPT 71-8B	Fine and coarse grained disseminated to massive chromite in pyroxene matrix. This sample is from same chromite lense as 71-8A	" "	"	"
3	TPT 71-9	Black Velvet mine, Canyon Mt., Coarse massive chromite in serpentine.	" "	346720	4912930
4	TPT 59-2	Iron King mine, Canyon Mt. Oregon, Coarse massive chromite in serpentine.	" "	346840	4912750
5	TPT 66-27	Ward mine, Coarse, massive chromite in serpentine.	" "	348980	4915840
6	TPT 66-124	Dunn-Carlsen Mine (hill top cut). Coarse massive chromite in serpentine.	" "	349060	4914975
7	TPT 66-121	Dunn-Carlsen Mine. Fine to coarse, massive to disseminated, euhedral-subhedral chromite in olivine.	" "	349200	4914870

		serpentine.				
9	TPT 66-125	East of Dog Creek. Coarse, massive chromite in serpentine.	"	"	349740	4915250
10	C-143-T	Saddle NW of Haggard & New mine. Massive chromite in serpentine.	"	"	350150	4914500
11	TPT 57-3	Kingsley mine. Massive chromite in serpentine	"	"	350040	4913900
14	TPT 59-60	Brecciated H&N . Massive chromite in serpentine.	"	"	350350	4913670
12	JD-42C	Lower Gardner mine near H&N. Massive chromite	"	"	350700	4914150
13	JD-43C	Middle Gardner mine. Massive chromite in dunite.	"	"	350800	491400
15	JD-15G	Present Need mine. Massive chromite	"	"	35060	4913260
16	TPT 66-60	West of Pine Creek. Massive chromite	"	"	352990	4912480
17	TPT 66-61	West of Pine Creek. Massive chromite in chlorite and serpentine	"	"	352960	4912400
18	TPT 66-63	Pine and Dean Creek, top pit. Massive chromite in serpentine.	"	"	353640	4913830
19	TPT 66-64	Pine and Dean Creek, bottom pit. Massive chromite in serpentine (poor analyses).	"	"	353380	4913960

20	TPT 66-137	Unnamed prospect east of Dean Creek Massive chromite in serpentine NW/4 NE/4 Sec. 11 T14S-R32E	"	"	353629	4915300
21	TPT 66-138	NE 1/4 Sec. 2 T14S-R32E. Massive chromite in serpentine	"	"	353850	4916200
22	TPT 66-1	Bald Eagle mine. Massive chromite	"	"	354980	4912560
23	C51T	Chambers mine (middle Orebody) Massive chromite cut by gabbro dike.	"	"	355450	4912260
24	C51T	see 25	"	"	"	"
25	C51T	see 25	"	"	"	"
26	TPT 67-1A	Chambers mine. Massive chromite showing some variations in comp.	"	"	355400	4912180
27	JD-30C	Chambers mine (east orebody). Massive chromite with pyroxene and olivine	"	"	355550	4912300
28	JD-30C		"	"	"	"
29	TPT 46-72	Celebration mine. Coarse chromite with diopside	"	"	355770	4910380
30	C-322T	Below Dry camp mine (Howard mine?) Massive chromite in serpentine	"	"	357450	4913750

31	C137T	Dry camp mine. Massive chromite in serpentine with some pyroxene	"	"	357950	4913700
32	C133T	Dry Camp mine. Coarse dissem. chromite in dunite	"	"	"	"
33	C193T	Dry Camp mine. Coarse, massive to dissem. chromite in olivine	"	"	"	"
34	C194T	Dry Camp mine. Massive chromite	"	"	"	"
35	JD-76C	Upper Howard mine. Massive chromite	"	"	357960	4914300
36	JD-77C	Lower Howard mine. Massive chromite	"	"	357950	4914350
37	TPT 66-78	U of O claim. Massive to dissem. chromite with pyroxene and olivine	"	"	358400	4911700
38	TPT 66-19	Ray Spring mine. Massive chromite	"	"	358850	4911060
39	TPT 66-20	Tip Top mine. Massive chromite in serpentine	"	"	358970	4910920
40	TPT 59-4	Ray mine. Coarse massive chromite with diopside and enst.	"	"	358970	4910920
41	TPT 66-18	Roadside mine. Massive chromite in serpentine	"	"	359540	4913380
42	TPT 66-17b	Ajax mine. Massive chromite with diopside and olivine	"	"	360200	4912450

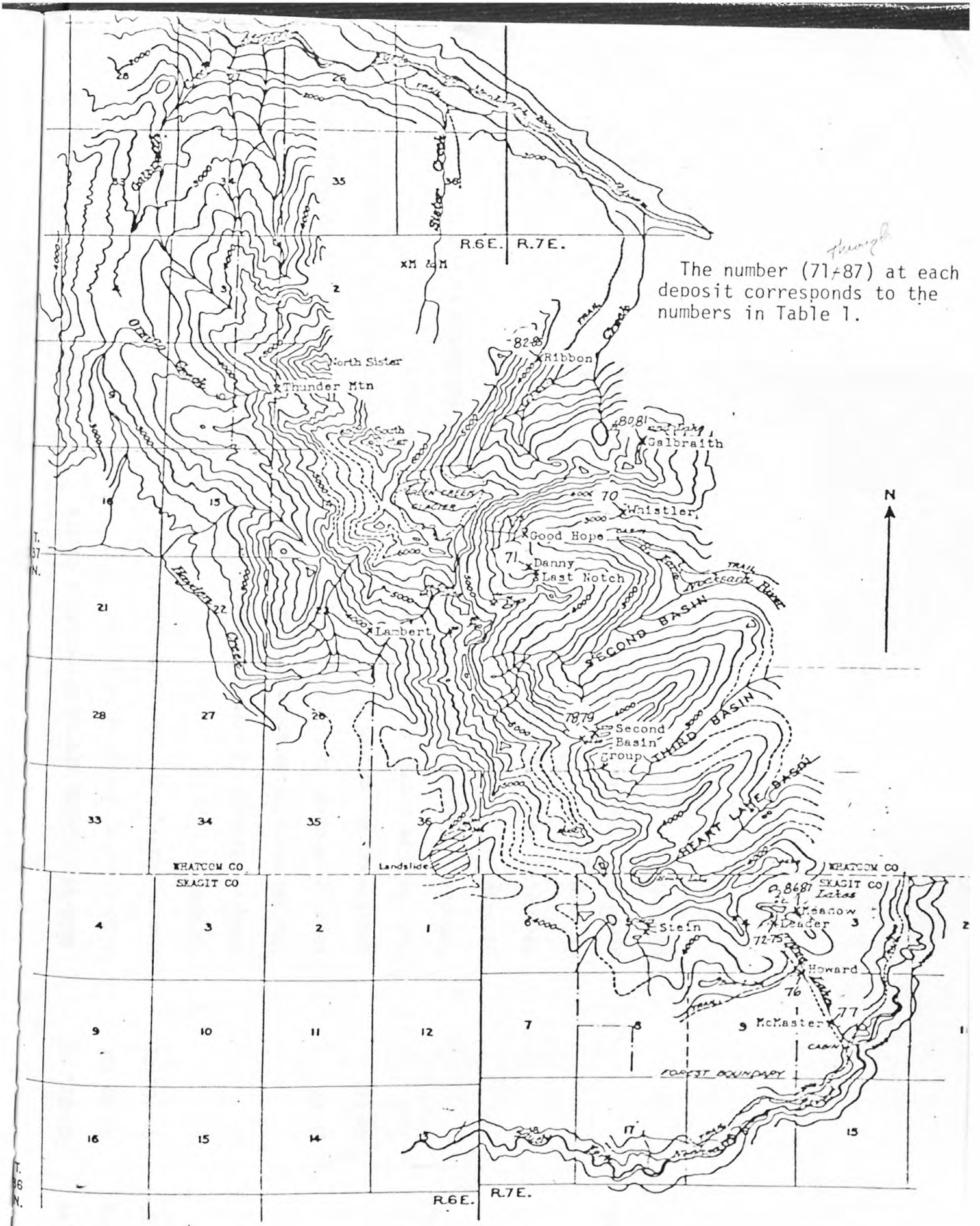
43	TPT 66-16	NW of Marks-Thompson. Massive chromite with some diopside	"	"	360380	4914800
44	C-196T	Mark's mine. Massive chromite	"	"	361050	4914250
45	C-195T	Marks-Thompson mine. Massive chromite	"	"	"	"
46	TPT 66-5	Overholt Creek. Massive chromite with diopside and serpentine	"	"	362000	4913650
47	TPT 66-6	Overholt Creek mine. Massive to dissem. chromite in serpentine	"	"	361800	4913200
48	TPT 66-7	Overholt Creek. Coarse chromite in serpentine	"	"	361750	4913050
49	TPT 66-9	Lost Buck mine. Massive chromite in serpentine	"	"	361425	4912025
50	TPT 66-10A	Above Lost Buck. Massive chromite in serpentine	"	"	361400	4911950
51	TPT 66-14	Campbell mine. Massive chromite with olivine and pyroxene	"	"	361800	4911300
52	TPT 66-14B	Campbell mine. Massive chromite with olivine and pyroxene	"	"	"	"
53	C160T	Campbell mine. Fine grained chromite in diopside	"	"	"	"
54	TPT 66-12	Sheep Rock	"	"	361600	4911000

55	TPT 66-13(R)	Big Bertha mine. Massive chromite with pyroxene and olivine	"	"	361700	4910025
56	TPT 66-133(M-1)	Potato Patch mine (2000'N of Norway mine). Massive, altered chromite in chlorite	"	"	341600	4916250
57	TPT 66-129(M-2)	Potato Patch or Norway. Massive chromite in chlorite	"	"	349480	4915840
58	TPT 66-129(M-2)	Ferritchromit in 66-129	"	"	349450	4915840
59	TPT 66-130(M-3)	Southwest Potato Patch. Massive, altered chromite in chlorite	"	"	341480	4915840
60	TPT 66-131(M-4)	Potato Patch (Norway Pit). Massive, altered chromite in chlorite	"	"	341450	4915780
61	TPT 66-116(M-5)	North of Eagles Nest. Massive chromite in serpentine	"	"	344020	4911130
62	TPT 66-35(M-6)	Silver's Lease. Massive chromite in chlorite	"	"	339220	4922460
63	TPT 66-36(M-7)	No. 1 West of Silver's Lease. Massive chromite	"	"	338820	4922300
64	TPT 66-37(M-8)	Silver's No. 2 West. Massive chromite in serpentine and chlorite chromite has much alteration	"	"	338680	4922300
65	TPT 66-38(M-9)	Dunn pit. Nodular ore on Laycock Creek	"	"	337650	4916950

66	TPT 66-39(M-10)	1st Pit south of Dunn., Mt. Vernon quadrangle Massive chromite	"	"	337600	4916630
67	TPT 66-40(M-11)	No. 2 south of Dunn. Massive chromite in serpentine and chlorite, chromite is very extensively altered and analysis shows presence of SiO_2 and probable water	"	"	337600	4916660
68	C320T	Dixie mine. Massive chrom. in dunite	"	"	SE 1/4 Sec. 18 T115, R34E	
69	JD-49C	Oregon mine. Massive chrom. in serpentine	"	"	NE cor. sec. 12 T155, R28E, Aldrich Mt. Quad.	

Twin Sisters Mountain, Skagit and Whatcom Counties, Washington

			E	N
70	Si-1	High-grade chromite in dunite Whistler claim	578500	4394000
71	Si-2	High-grade chromite in dunite Danny Claim	577200	5393200
72-75	Si-4,5,10	Leader claim, chromite in dunite	580900	5387500
76	Si-12	Howard claim, chromite in dunite	581300	5386900
77	Si-15	McMaster claim, high grade chromite in dunite	581750	5386500
78	Si-19	Second Basin, 4370' , chromite in dunite	578100	5390500
79	Si-20	Orbicular chromite in dunite, Floats, Second Basin	578000	5390500



...logy and topography by T. P. Thayer and A. B. Griggs

Figure 2. PRINCIPAL CHROMITE DEPOSITS OF THE TWIN SISTERS MOUNTAINS, WASHINGTON

80,81	Si-23, 24	Galbraith Claim, coarse chromite in dunite	"	"	578800	539510
82-85	Si-30-35A	Rubbon claim, chromite in dunite	"	"	577100	539640
86,87	Si-48, 49	Meadow claim, how-high grade chromite in dunite	"	"	581250	538775
88		Massive chromite in serpentinized olivine	Wood Mine, Lancaster, Pa			
89		Massive chromite in serpentinized olivine	"	"		
90	66-K2	Massive chromite in olivine	Gardner mine, Klamath, Oregon			
91	NC-14B	Massive chrom. in dunite	Tiebaghi mine, New Caledonia			
92		PaK, Massive chrom. in serp. olivine	Pakistan			
93		Troodas-1, Massive chromite in serp. olivine	Troodas Complex, Cyprus			
94		Troodas-2, Recrystallized skeletal chromite in serp. olivine	"	"		
95-96		Accessory to massive chromite with serp. pyroxene.	Buck Creek, N. Carolina			

97	LHA	Massive chromite in serp. olivine	Dark Creek, N. Carolina Lawhead A
98	LHB	Massive chrom in serp. olivine	Dark Creek, N. Carolina Lawhead B
99		Massive chromite in serp. dunite	Guleman mine, Turkey
100	61-Cr9	Massive chrom. in serp., McGuffy Creek, California	McGuffy Creek, CA
101	59-NZ18	Massive chrom.	Dun Mountain, New Zealand
102	69-G5	Accessory chrom. in serp.	Apenine Mts., Italy
103	69-G5	(see 102)	
104	69-G7	(see 102)	
		Coolac Complex, New South Wales, Australia	
105	A-645	Massive chromite in serp. dunite,	Honeysuckle range, NSW
106	A-317	Massive chromite in serp. peridotite, East Ridge	Mt. Lightening, SE, NSW
107	A-1280	Massive chromite,	Mooney-Mooney range, NSW
108	A-36	Massive chromite in serp. peridotite.	" "

109	A-40A	Massive chromite with serp. peridotite.	Mooney-Mooney range, NSW
110	A-40B	Massive chromite in serpentine.	" "
111	A-89	Massive chromite in serp. dunite	" "
112	A-154	Massive chrom. in serp.	Mt. Lightening, West, NSW
113	A-183	Massive chrom. in serpentine,	" South "
114	A-199	Massive chromite in serpentine,	" " "
115	A-284	Massive chrom. in serpentine,	" East "
116	A-318	Massive chrom. in serpentine, East Ridge	" SE "
117	A-509	Massive chrom. in serpentine,	Honeysuckle range, NSW
118	A-749	Massive chromite in serpentine dunite.	" "
119	A-885	Massive chromite in serpentine	" "

No. of analysis	Field No.	Sample desicriptions	Location	UTM Coordinat E	N
120-123	44T37	Chromite layer in dunite anorthosite contact float from hillside on Isabel group, south of Gomo, Camaguey	Cid Mine, Camaguey, Cuba		
124-127	Cu7	Chromite in gabbor	"	"	
128	Cu-9A	Chromitite cut by gabbro dike	"	"	
129	Cu-11	Chromite in gabbro	Teide mine	"	
130-133	42T49	Chromitite cut by gabbro dike. Chromite in gabbro.	Guillermina Mine	"	
134-137	Cu47	Cored nodules	"	"	
138-141	Cu45T	Nodular chromite	"	"	
142-144	Cu52	Nodular chromite	"	"	
145-147	Cu-109	Nodular chromite in troctolite	"	"	
148-150	44T3	Chromite-plagioclase cumulate	La Perla Mine	"	
151-156	44T1[1/]	Chromite	Jose Mine	"	
157-160	42T55	Chromite	Jose Mine	"	

1/ From Moa-Baracoa district, Oriente Mine, Camaguey, Cuba.

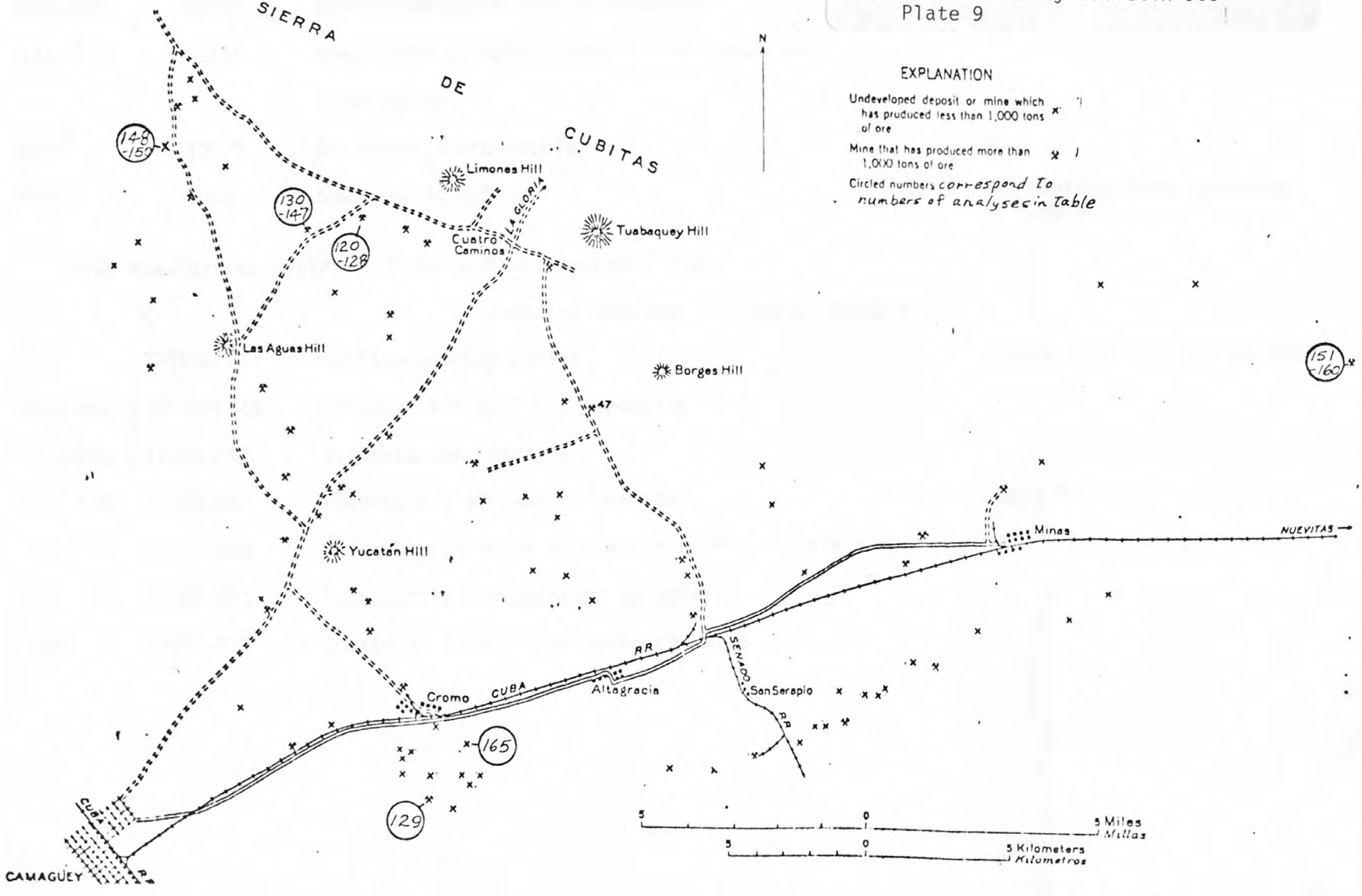


Figure 3.--Index map of the Camaguey district, Cuba, showing the distribution of chrome deposits and principal producing mines. The circled numbers indicate the mines sample used in this report. The number corresponds to the analyses of Table 1.

161-162 [1]	42T33	Gabbro pegmatite dike in chromite	Cromita Mine, Punta Gorda, Cuba
163 [1]	Cu137	Brecciated chromite; pebble from Yamaniguey River below	Potosi Mine, Canete
164 [1]	42T39	Chromite-gabbro beccia	" "
165	Cu28	Chromite in gabbro	La Caridad Mine, Camaguey (Robles)

[1] From Moa-Baracoa district, Oriente Mine, Camaguey, Cuba

Zambales Complex, Philippine Republic

166	TPT59-P55	Sulfide-bearing dunite	Acoje Mine, Philippine Rep.
167-168	TPT59-P54A	Chromite and sulfides in dunite	" "
169-170	TPT59-P47	Disseminated chromite	" "
171-176	TPT59-P4	Feldspathic olivine chromitite	Coto Mine "
177	TPT59-P10	Accessory chromite in olivine gabbro, Slawis River	" "
178-179	TPT59-P13	Feldspathic disseminated chromitite	" "
180	TPT59-P15	Coarse to fine disseminated chromite	" "

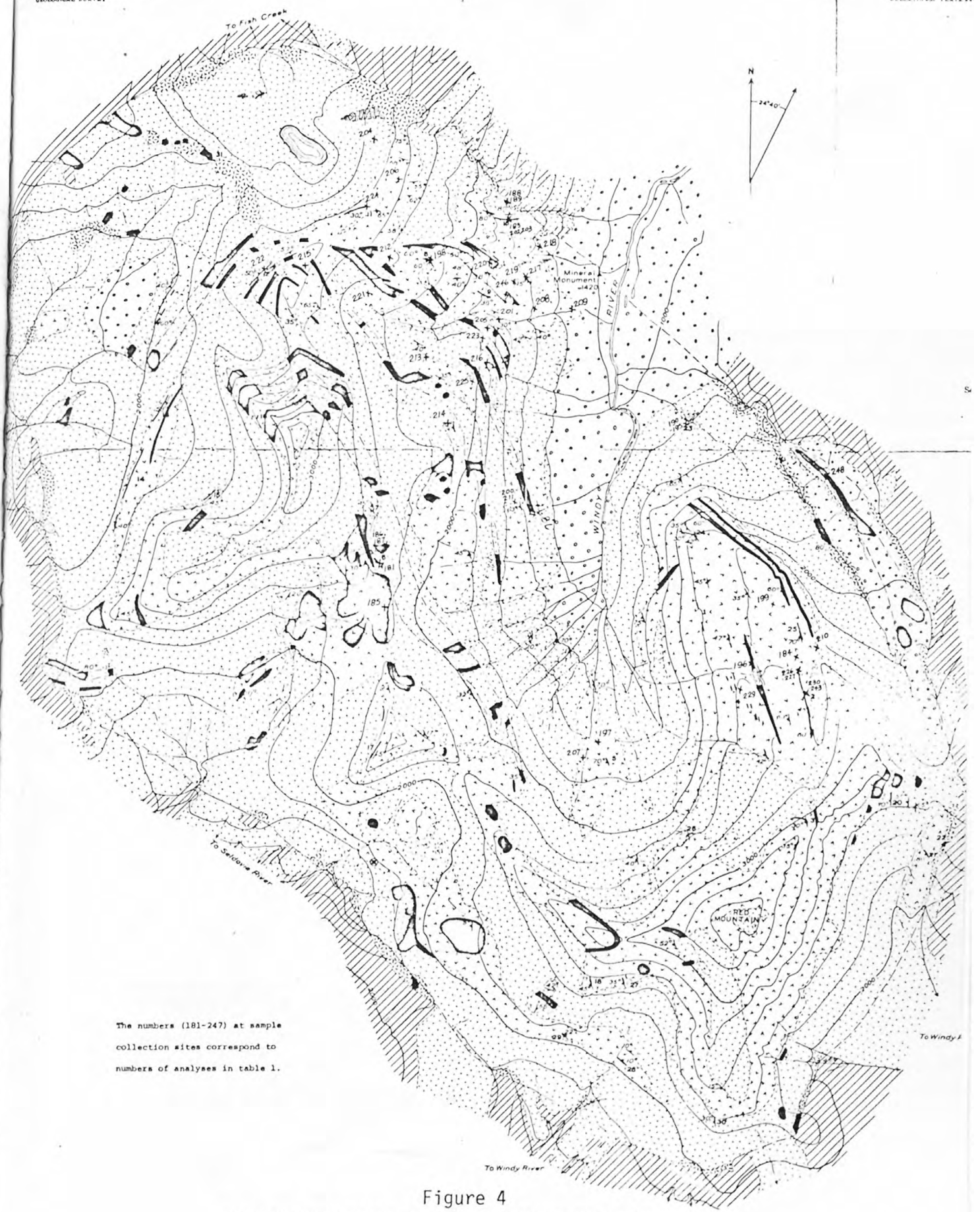
Red Mountain, Kenai Penin, Alaska

181	AGK-335B	High grade chromite with olivine and pyroxene	Red Mountain,	Alaska
182	AGK-335B	Accessory chromite in peridotite	"	"
183	R26G	Massive chromite with pyroxene (same location as 203)	"	"
184	AGK-304	Massive chromite with olivine	"	"
185	ACK-336A	Massive chromite with olivine	"	"
186	ACK-334	Accessory chromite with olivine and pyroxene	"	"
187	ACK-334	Accessory chromite with olivine and pyroxene	"	"
188	ACK-349	Chromitite cut by dikelets of pyroxene and feldspar	"	"
189	ACK-349	Chromitite cut by dikelets of pyroxene and fledspar	"	"
190	ACK-373	Massive cumulate chromite with olivine	"	"
191	ACK-373A	Massive chromite in dunite. Sample ACK-373A-E taken in a stratigraphic section	"	"
192	ACK-373B	Massive chromite in dunite	"	"
193	ACK-373C	Massive chromite with olivine	"	"
194	AKC-373D	Massive to access. chromite in dunite	"	"
195	ACK-373E	Massive chromite with olivine	"	"
196	ACK-307	Accessory chromite in peridotite	"	"

197	ACK-353	Massive chromite with olivine	Red Mountain, Alaska
198	ACK-371	Massive chromite with olivine	" "
199	ACK-309	Accessory chromite in peridotite	" "
200	ACK-338	Massive chromite in olivine chromitite	" "
201	ACK-325	Accessory chromite in peridotite	" "
202	ACK-348	Massive cumulate chromite in dunite	" "
203	ACK-348	Massive chromite with pyroxene recrystallized texture and lies immediately above sample 202	" "
204	ACK-367	Accessory chromite in peridotite	" "
205	ACK-326	Accessory chromite in pyroxenite	" "
206	ACK-366	Accessory chromite in peridotite	
207	ACK-355	Massive chromite in olivine chromitite	" "
208	ACK-320	Accessory chromite in peridotite	" "
209	ACK-319	Accessory chromite with pyroxene and some olivine	" "
210	ACK-305B	Accessory chromite in peridotite	" "
211	ACK-338A	Massive chromite with olivine	" "
212	ACK-381	Accessory chromite in peridotite	" "
213	ACK-382	Accessory chromite in peridotite	" "
214	ACK-331	Cumulate chromite with olivine	" "

215	ACK-361	Massive cumulate chromite with olivine	Red Mountain, Alaska
216	ACK-329	Massive chromite with olivine	" "
217	ACK-321	Chromite in peridotite	" "
218	ACK-359	Chromite in peridotite	" "
219	ACK-322	Cumulate chromite with olivine	" "
220	ACK-324	Chromite in peridotite. Same enstatite present	" "
221	ACK-379	Accessory chromite in peridotite	" "
222	ACK-360	Cumulate chromite with olivine	" "
223	ACK-327	Cumulate chromite with olivine	" "
224	ACK-365	Massive chromite with olivine	" "
225	ACK-330	Cumulate chromite in dunite	" "
226	ACK-305C	high grade chrom in dun.	" "
227	ACK-305A	" " " " "	" "
228	R29G	" " " " "	" "
229	ACK-308	Access. chrom. in dunite	" "
230	ACK-306A	Cumulate chromite with olivine	" "
231	ACK-306B	Massive stratigraphic section olivine chromitite	" "
232	ACK-306C	Massive chromite with olivine	" "
233	ACK-306D	Massive chromite with olivine	" "
234	ACK-306F	Massive chromite with olivine	" "
235	ACK-306H	Massive chromite with olivine	" "
236	ACK-306I	Accessory chromite in peridotite grading to pyroxenite	

237	ACK-306I	Accessory chromite in peridotite grading to pyroxenite	" "
238	ACK-306I	Accessory chromite in peridotite grading to pyroxenite	" "
239	ACK-306K	Massive chromite with olivine	" "
240	ACK-306L	Massive chromite with olivine	" "
241	ACK-306M	Massive chromite with olivine	" "
242	ACK-306N	Cumulate chromite in peridotite	" "
243	ACK-306Ø	Accessory chromite in peridotite	" "
244	R54G	Accessory chromite in peridotite	" "
245	R40G	Massive chromite with olivine	" "
246	ACK-323	Accessory chromite in pyroxenite	" "
247	R29G	Massive chromite with olivine	" "
248	P19G	Massive chromite with olivine	Claim Point, Alaska
249	P14G	Accessory chromite in dunite	" "
250	EK-14A	Massive chromite in dunite	Eklutna Complex, Alaska
251	EK-14B	Cumulate chromite in peridotite	" "
252	EK-14C	Accessory chromite in peridotite	" "
253	TPT72-B19	Cumulate chromite in serpentine	Araguacema, Brazil
254	TPT69-B12a	Cumulate chromite in serpentine	Niquelandia, Goias, Brazil



The numbers (181-247) at sample collection sites correspond to numbers of analyses in table 1.

Figure 4

GEOLOGIC AND TOPOGRAPHIC MAP OF RED MOUNTAIN, KENAI PENINSULA, ALASKA

1000 0 2000 Feet

Contour interval 200 feet

Datum is approximate mean sea level

Topography and geology by P. W. Guild,
assisted by R. J. Anderson
Surveyed in 1940

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