# CHEMICAL COMPOSITION OF NORTH CAROLINA CHROMITE

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## Abstract

The purpose of this project was to produce products, for analysis, that would indicate the ultimate purity of chromite existing in North Carolina. Twelve deposits were sampled for chromite, and ten of these were sufficiently concentrated to reveal the ultimate purity of the chrome-spinel constituent. Each of the ten had an indicated ultimate analysis greater than fifty percent $Cr_2O_3$.

## Introduction

Previously published work on North Carolina chromite had indicated that all the material was too low in $Cr_2O_3$ content to be of value for any use. International publications showed North Carolina material grouped with Montana and Oregon low grade material, running from sixteen to forty-five percent $Cr_2O_3$ content.

Close examination of some of the reports on North Carolina chromite showed an error between data and interpretation. Some analyses reported as chromite mineral showed a substantial percentage of $SiO_2$. A close examination of the crystal structure of chromite reveals silica can not substitute in the system. Therefore, it must be assumed that the $SiO_2$ reported was not in the chromite, but instead was present in a gangue dilutent.

Based on this assumption, calculations were made, and preliminary tests were run. The results of this preliminary work were published in the report, "Some Aspects of Chromite with Regard to Possible Uses of North Carolina Material", January 1970 Progress Report. Those tests showed certain deposits did contain chromite of high $Cr_2O_3$ content. This report covers the subsequent work on twelve known chromite occurrences in North Carolina.

## Objective

The object of this work was to determine if chromite occurrences in North Carolina were of a high chromium content.

## Procedure

Sample description:

| Lab No. | Location Name | County | Date Collected | Remarks |
|---|---|---|---|---|
| 1789 | Addams Mountain | Wake | 7-7-60 | Core drilling |
| 3283 | Balsam Gap | Jackson | 4-23-68 | Bag on property |
| 3460 | Democrat | Buncombe | 5-15-69 | Old dump |
| 3461 | Holcombe Branch | Madison | 5-15-69 | Stream deposit |
| 3464 | Day Book | Yancey | 5-15-69 | Fresh material |
| 3468 | Dark Ridge | Jackson | 5-21-69 | Old dump |
| 3469 | Webster | Jackson | 5-21-69 | Old dump |
| 3470 | Addie | Jackson | 5-21-69 | Fresh material |
| 3589 | Morgan Hill | Buncombe | 2-12-70 | Auger sample |
| 3608 | Ellijay | Macon | 3-13-70 | Old workings |
| 3609 | Corundum Hill | Macon | 7-13-70 | Stream deposit |
| 3626 | Newdale | Yancey | 3-27-70 | Fresh material |

The test procedure used was, in most cases, a standard developed in previous work. This procedure is as follows:

## Chromite Beneficiation Procedure

Starting with a preferably high grade chromite sample:

1) Jaw crush to minus ½-inch

2) Roll crush in closed circuit with ¼-inch screen

3) Roll and split into 500-gram samples

4) Rod mill: stainless steel mill, 10 large rods, 2 minutes, 65% solids, 2.0 lbs/ton NaOH

5) Screen on 20 mesh, dry and bag plus 20 mesh

6) Deslime on 200 mesh, 2 times with full bucket, with one minute settling time. Settle, dry and bag minus 200 mesh

7) Scrub in Wemco scrubber (3 tier type) for 15 minutes at 75% solids with 2.0 lbs/ton NaOH at 1750 rpm

8) Deslime same as step 6

9) Dry and weigh minus 20 plus 200 mesh product

10) Cut out two 50-gram samples

11) Separate with heavy liquids at 2.96 sp. gr.

12) Wash and dry products, weigh and bag each

13) Separate concentrate sinks on Frantz Isodynamic separator at vertical fall settings, upper indicator at 5 cm, lower indicator at 20 cm, amps at 0.25-0.40 (adjust to suit sample)

14) Clean concentrate with inclined chute settings, back slope at 15°-20°, down slope at 10°, amps at 0.40-0.60

15) Determine specific gravity of concentrate

*16) Split out analysis sample (5 grams)

17) React with hot concentrated HCl with stirring, once for 15 minutes, wash, and then for 45 minutes (more depending on amount of gangue)

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*Analysis at step 16 is reasonable analysis to expect by mineral processing.

18) Wash and dry concentrate

19) Separate with heavy liquids at 2.96 sp. gr.

20) Clean concentrate with inclined chute settings on Frantz Isodynamic separator, back slope at $15^{o}$-$20^{o}$, down slope at $10^{o}$, amps at 0.40-0.60

21) Determine specific gravity of concentrate

*22) Split out analysis sample. (5 grams)

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*Analysis at step 22 is ultimate to expect of chrome-spinel.

In the case of the stream deposits, auger sample, and the highly weathered samples, the crushing procedure was eliminated. And either tabling or a double scrubbing process was substituted.

Chemical analyses were run on products at steps 16 and 22. The procedure used to determine $Cr_2O_3$, FeO and $SiO_2$ content is described in the U. S. Geological Survey Bulletin No. 1084-B, "Rapid Analysis of Chromite and Chrome Ores", by Joseph I. Dinnin, 1959.

Calculation on the ultimate $Cr_2O_3$ analysis is based on the fact that the olivines associated with the chromites contain upwards of forty percent $SiO_2$. Therefore residual $SiO_2$ in the analysis of material from step 22 was used to calculate the final figure.

$$\%Cr_2O_3 \div (1.0 - \frac{SiO_2\%}{0.4}) = \text{Final } Cr_2O_3 \text{ content}$$

Results

The results of the analyses and calculations are shown in the following table.

| Location Name | Analysis Point | % $Cr_2O_3$ | % FeO | % $SiO_2$ | Cr:Fe | Sp.Gr. | Caculated $Cr_2O_3$ |
|---|---|---|---|---|---|---|---|
| Addams Mountain | #16 | - | - | - | - | - | - |
| | #22 | 36.0 | 14.5 | 6.0 | 2.2 | 3.9 | 42.0 |
| Balsam Gap | #16 | - | - | - | - | - | - |
| | #22 | 34.8 | 14.1 | 3.3 | 2.2 | 4.1 | 37.9 |
| Democrat | #16 | 42.0 | 20.4 | 8.0 | 1.81 | 4.1 | - |
| | #22 | 49.2 | 23.1 | 3.2 | 1.87 | 4.4 | 53.5 |
| Holcombe Branch | #16 | 50.1 | 27.5 | 2.9 | 1.60 | 4.5 | - |
| | #22 | 54.4 | 25.8 | 2.3 | 1.86 | 4.5 | 57.7 |
| Day Book | #16 | 55.5 | 19.6 | 2.4 | 2.49 | 4.4 | - |
| | #22 | 57.2 | 20.0 | 1.4 | 2.52 | 4.5 | 59.3 |
| Dark Ridge | #16 | 49.2 | 18.2 | 2.9 | 2.38 | 4.2 | - |
| | #22 | 51.7 | 18.8 | 1.9 | 2.42 | 4.4 | 54.3 |
| Webster | #16 | 45.2 | 25.6 | 3.6 | 1.55 | 4.3 | - |
| | #22 | 47.1 | 25.8 | 3.7 | 1.61 | 4.3 | 51.9 |
| Addie | #16 | 48.6 | 25.3 | 5.4 | 1.69 | 4.5 | - |
| | #22 | 52.0 | 26.1 | 2.6 | 1.75 | 4.5 | 55.6 |
| Morgan Hill | #16 | 50.8 | 28.0 | 4.0 | 1.60 | 4.4 | - |
| | #22 | 53.1 | 27.1 | 2.6 | 1.72 | 4.6 | 56.8 |
| Ellijay | #16 | 11.7 | - | - | - | - | - |
| | #22 | 46.4 | 33.4 | 5.2 | 1.22 | 4.6 | 53.3 |
| Corundum Hill | #16 | 40.3 | 34.4 | 2.8 | 1.09 | 4.8 | - |
| | #22 | 54.6 | 29.6 | 1.6 | 1.62 | 4.8 | 56.9 |
| Newdale | #16 | 51.4 | 28.5 | 2.5 | 1.59 | 4.6 | - |
| | #22 | 53.2 | 29.0 | 1.3 | 1.61 | 4.7 | 55.0 |

## Discussion

Examination of the calculated compositions shows that high-$Cr_2O_3$-content chromite does exist in North Carolina. This contradicts most other reports on North American chromite deposits.

The presentation of this data does not mean to say, or imply, that any of these deposits could profitably be worked for chromite. It is extremely doubtful that a processing plant could produce a product of this quality through simple physical procedures. It is not even known whether or not any of this material, if produced, would meet market specifications.

However, with the continued embargo on Rhodesian chromite, and recent price increases by the Russians, the chromite consuming industries might soon start seeking new types and sources of chrome bearing minerals. And with the recent expansions in the olivine industry, the possibility that chromite might be produced as a by-product is also increasing.

## Conclusions

Results of the tests on ten of the twelve samples tested indicate a $Cr_2O_3$ content of fifty percent or better.

None of the deposits tested indicate the presence of sufficient quantity or quality of chromite to warrant processing exclusively for that mineral. However each deposit is located favorably to warrant by-product production from an olivine operation.

Consumers should be made aware of the existence of a supplementary source of chromite here in North Carolina.

Recommendations

Future work should be encouraged toward finding and evaluating end-product uses for chromite produced as a by-product of olivine mining and milling.