Property File 82 NE 045

Griffin Lake

004412

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December 10, 1987.

Mr. J.A.Currie
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Peachland, B.C.

RE: INVESTIGATION OF REVELSTOKE GARNET

Purpose of Investigation

Two samples of garnet concentrate were received, one from a commercial property (Emerald Creek) and the other from the property under consideration, near Revelstoke. The purpose of the investigation was to compare the two garnets in all respects in order to determine if the Revelstoke garnets were similar enough to the garnets from the producing property to warrant further consideration.

Scope of Investigation

This investigation was restricted to enough petrographic, X-ray, chemical analysis, and physical property testing to compare the Revelstoke garnets to the Emerald Creek garnets. No testing of a commercial nature, i.e. testing of the Revelstoke garnets under conditions of use, was attempted.

Comparison of Properties

The properties of the two garnets are summarized as follows:

	REVELSTOKE	EMERALD CREEK - Idaho
TYPE:	Almandine, $Fe_3Al_2(SiO_4)_3$	Almandine
	(substitution of Mg, Mn for Fe in both)	
CHEMISTRY:	Whole Rock Analysis, (%)	
SiO_2	37.22	36.59
Al_2O_3	20.07	21.07
Fe_2O_3	30.11	35.75
MgO	6.65	2.39
CaO	2.48	1.23
Na_2O	0.10	0.02
K_2O	0.20	0.10
TiO_2	0.42	0.15
P_2O_5	0.38	0.40
MnO	1.18	1.64
LOI	1.38	2.37

SEM Study

No variation detected in chemistry between grains or from rims to cores in either the Revelstoke or the Emerald Creek garnets. Study confirms on microscopic scale that Revelstoke garnet is higher in Mg, slightly higher in Ca, and slightly lower in Mn and Fe than the Emerald Creek garnet (see SEM traces in Appendix).

	Revelstoke	Emerald Creek
HABIT:	Elongated, irregular fragments; rare crystals Commonly fractured Inclusions common	Euhedral crystals, smooth boundaries; rare fragments Rarely fractured Inclusions common
HARDNESS: Moh's	7.5	7.5
Tukon Micro-indentation (numbers relative only)	1.33	1.22
SPECIFIC GRAVITY:	3.84	4.17

Methods of Testing

The whole-rock chemistry was provided by Brenda Mines Ltd., from analyses carried out by Chemex Laboratories in Vancouver, B.C.

In order to further characterize the chemistry on a microscopic scale and to carry out micro-hardness tests, a polished section of mounted grains of each sample was prepared. SEM analysis was carried out at U.B.C by Mr. John Knight; results are tabulated above and data are collected in the Appendix.

Hardness of the two garnets was estimated by crushing a few grains of each in turn on large, fresh, smooth flat crystals of feldspar, quartz, and topaz (Moh's hardnesses of 6, 7, and 8 respectively). Both garnets were found to scratch feldspar and quartz but neither could produce a scratch in topaz, indicating a hardness of about 7.5 for each. At the same time, crushing tests between these minerals and clean glass plates gave qualitative indications that the Revelstoke garnet was more easily crushed than the Emerald Creek garnet (probably because of the euhedral crystal form of the latter, as opposed to the broken fragments of the former). However, this might indicate that the Emerald Creek garnets are more durable than the Revelstoke garnets.

A Tukon microhardness indentation tester in the Metallurgical Department at U.B.C. was used to make more quantitative hardness comparisons than were possible with minerals in Moh's scale. Highly polished grains in the same mounts used for SEM studies were subjected to repeat analyses of multiple points in several grains. Although this is merely an empirical test, with a poorly understood theoretical basis in brittle silicate minerals (as opposed to ductile sulfides and metals), the results indicated good reproducibility. For this reason, the results are taken to indicate a useful comparison. The diagonal widths of indentation were measured with a constant (200 g) load; they ranged from 70 to 80, average 75 (arbitrary units) for the Revelstoke garnet and 75 to 90, average 82, for the Emerald Creek garnet. Since the hardness is inversely proportional to the width of the indentation, these translate into the relative hardnesses of 1.33 and 1.22 listed above. The Revelstoke garnet would seem to be a little harder, if anything, than the Emerald Creek garnet.

A thin section of each garnet concentrate was also prepared, in order to supplement binocular microscope examination of the grains. These examinations revealed that both garnets contain numerous inclusions, commonly varying between 0.01 and 0.1 mm in size. These inclusions include quartz, feldspar, biotite, and sillimanite in both cases. Perhaps more significantly, however, the examinations showed that the Revelstoke garnets are much more fractured than those from Emerald Creek, and are almost invariably irregular fragments rather than the euhedral crystals common in the Emerald Creek concentrate.

The specific gravities of the two garnet concentrates were measured on hand-picked subsamples weighed first in air and then in water.

Discussion of Results

The Revelstoke garnets seem to be comparable with the Emerald Creek garnets in almost every way except in their degree of fracturing and lack of euhedral crystals. This might be advantageous, though: although the Emerald Creek garnets may be tougher or more durable as indicated by both the crushing tests and the euhedral crystals, the Revelstoke garnets may be capable of producing a sharper, more irregular and angular or abrasive particle.

As mentioned in Ladoo and Myers (1951), the commercial value of abrasive garnet depends upon its hardness, toughness, cleavage or fracture, and purity. "There are no standard specifications and tests for abrasive garnet, and actual use is the only means of valuation." The Revelstoke garnets meet the minimum requirements listed by Ladoo and Myers (hardness of at least 7.5; coarse grains that will yield sharp, angular grains in the full range of sizes from 20 to 200 mesh; unweathered; and breaking in long scale-shaped grains). The only varieties used are the iron-rich almandine or iron-manganese rich rhodolite, which the Revelstoke garnet certainly is. The differences in specific gravity are not significant,, since as Ladoo and Myers point out, a similar variation from 3.8 to 4.1 can exist in a single producing deposit.

Conclusions

The Revelstoke garnet appears, from all the testing carried out, to be comparable to the Emerald Creek garnet in all its properties except for its higher fracture density. This, combined with its occurrence as irregular fragments rather than euhedral crystals, seems to make it less tough (durable) than the Emerald Creek garnet. However, it might also make it break into the elongated fragments which are more abrasive and therefore more desirable in the industry. Further testing by use seems to be warranted and is recommended.

C.A.B. Leitch, P. Eng.

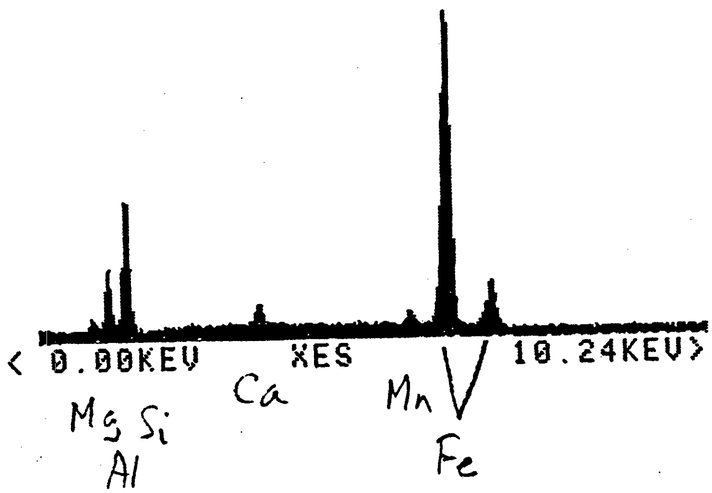
APPENDIX: SEM TRACES AND REFERENCE MATERIAL

BEATY GEOLOGICAL LTD.

REVELSTOKE Grain (1) Z=00

PR= 50KI 44SEC 50000 INT

V=4096 H=40KEV 1:1H AQ=40KEV 1H



REVELSTOKE Grain (2) Z=00

PR= 50KI 46SEC 50000 INT

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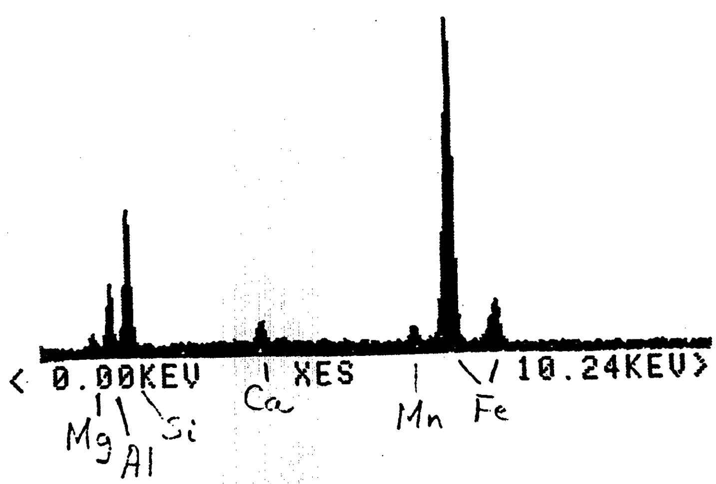
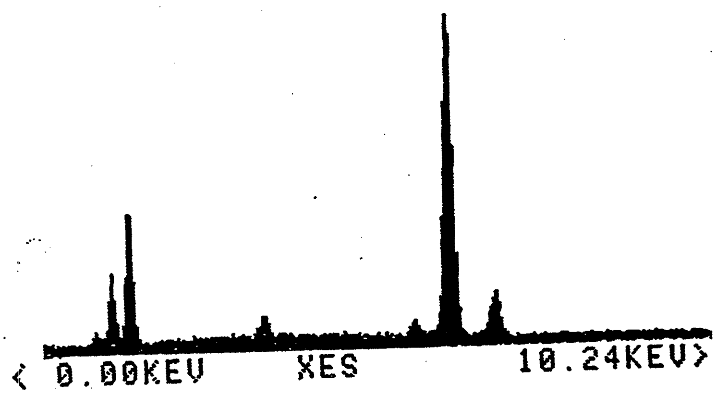
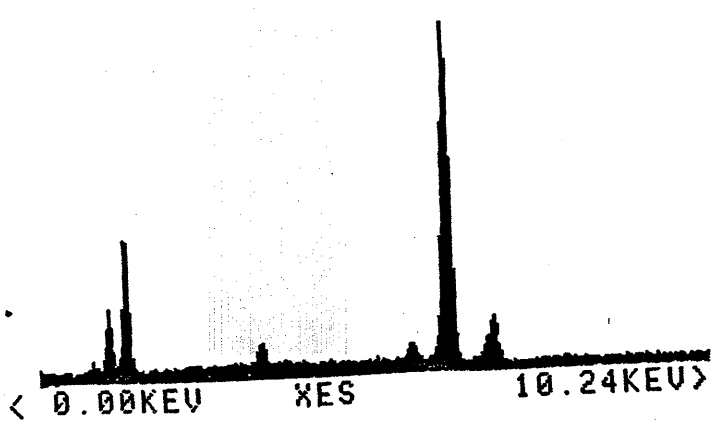


REVELSTOKE RIM Z=00
PR= 50KI 39SEC 50000 INT
V=4096 H=40KEV 1:1H AQ=40KEV 1H



REVELSTOKE CORE Z=00
PR= 50KI 41SEC 50000 INT
V=4096 H=40KEV 1:1H AQ=40KEV 1H



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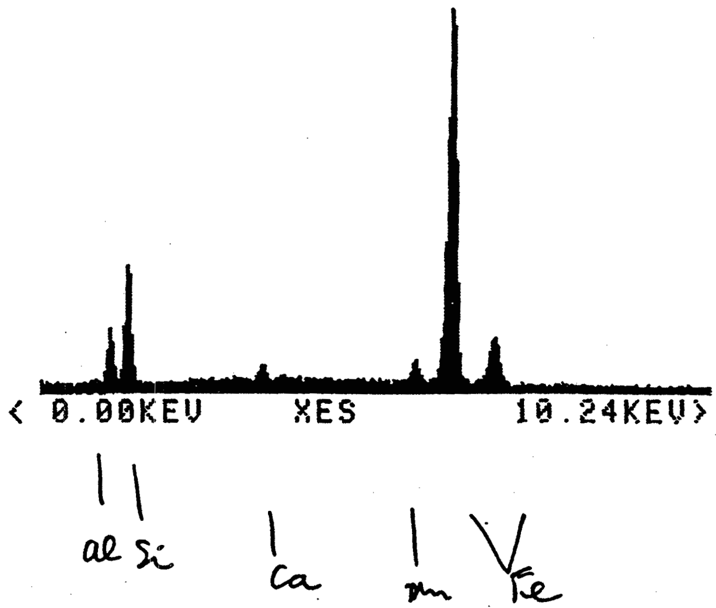
EMERALD CREEK Grain ① Z=00

PR= 50KI 26SEC 50000 INT

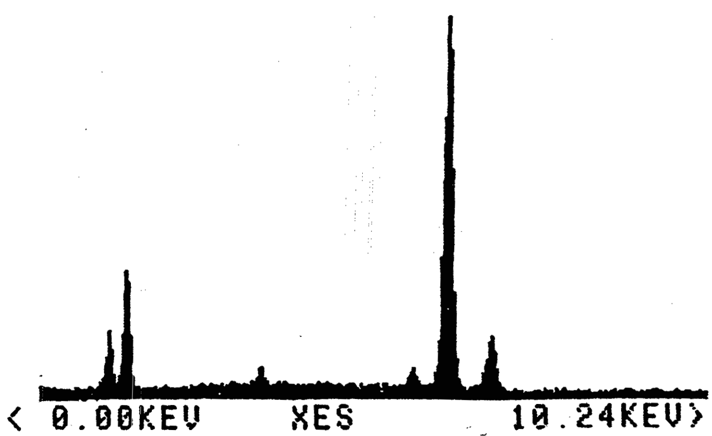
V=4096 H=40KEV 1:1H AQ=40KEV 1H

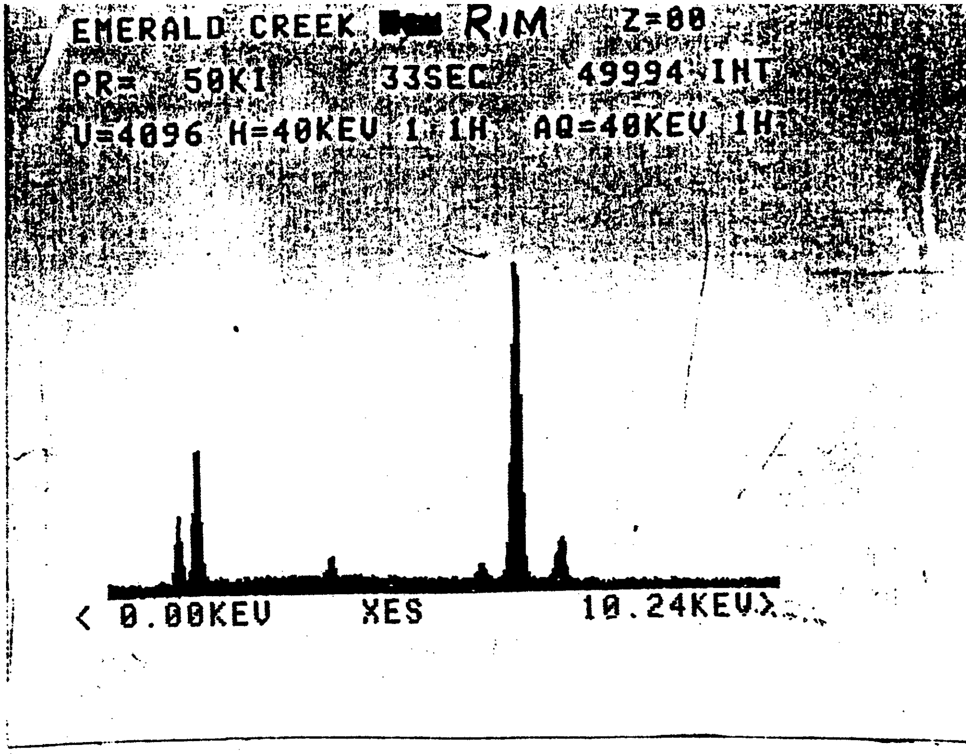


EMERALD CREEK Grain ② Z=00

PR= 50KI 27SEC 49996 INT

V=4096 H=40KEV 1:1H AQ=40KEV 1H




EMERALD CREEK [redacted] RIM Z=00
PR= 50KI 33SEC 49994 INT
V=4096 H=40KEV 1:1H AQ=40KEV 1H
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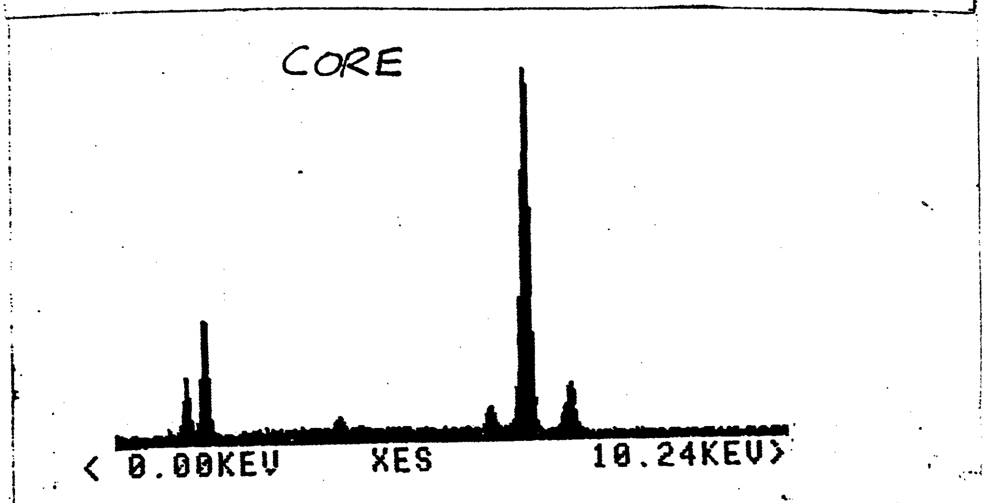
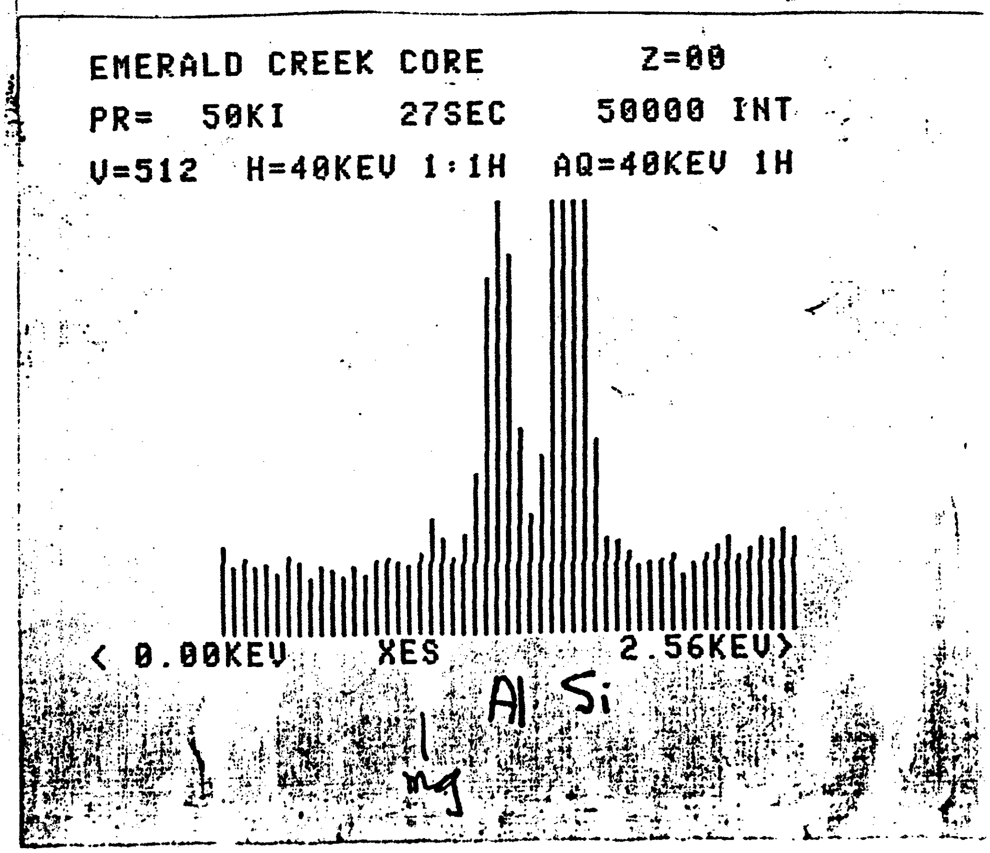

CORE
< 0.00KEV XES 10.24KEV>


EMERALD CREEK CORE Z=00
PR= 50KI 27SEC 50000 INT
V=512 H=40KEV 1:1H AQ=40KEV 1H
< 0.00KEV XES 2.56KEV>
Al Si
mg

Hist. accum. of gn + li in alluvial fan
Fortynine ch.