129

Chambigne Garnet Pty Ltd
A.C.N. 061 315 795

GPO Box 865
Brisbane Qld 4001
Tel: 07 3808 7900
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Ref:270397B

The Director of Titles Administration
NT Dept. Mines & Energy
GPO Box 2901
DARWIN NT 0801

ANNUAL REPORT TO MARCH 1997 RE: MLS 155

During the course of our exploration program in the Harts Range area, on other EL's held by Chambigne, we have taken time to inspect the above mentioned lease.

We have ensured that the lease pegs are in order having cleared such vegetation as may have grown to obscure them.

Since the granting of this lease, there has been no other field activity (exploration) whatsoever in this particular tenement. At the same time, heavy mineral (garnet) concentrates, acquired during the exploration phase for this ML, have been undergoing continued metallurgical testing, product evaluation and characterisation, in common with the other ML's clustered around this one, and held by Chambigne (all this is in conjunction with concentrates acquired from our major EL's, namely 8076 - 8384 - 8423 and 8829)

It has always been Chambigne's aim to produce consistent first class world standard garnet product. It is the roll of the small but important resource within this ML to be blended with primary production from the larger deposits in the Plenty and Entire River systems. Consequently, material from this ML will be worked according to the need for various blending grades to ensure the high quality of our product range.

As originally stated, we will inform the Department of Mines and Energy prior to any anticipated field activity in MLS 155.

Yours faithfully

R JOLLY
MANAGING DIRECTOR

Chambigne
Garnet Pty Ltd
A.C N 061 315 795

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Tel: 07 3808 7900
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ANNUAL REPORT 1997 - MLS155 - MLS162 inclusive

Additional Information

1. Sample Locations
2. Metallurgical Testing
3. Expenditure Incurred

Department of Mines and Energy

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PROMOTING GROWTH THROUGH RESOURCES

RESOURCE DEVELOPMENT DIVISION

FACSIMILE: 08 89 814 806
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Our Ref: MLS155
Your Ref: 270397B

Mr R Jolly
Managing Director
Chambigne Garnet Pty Ltd
GPO Box 865
BRISBANE QLD 4001

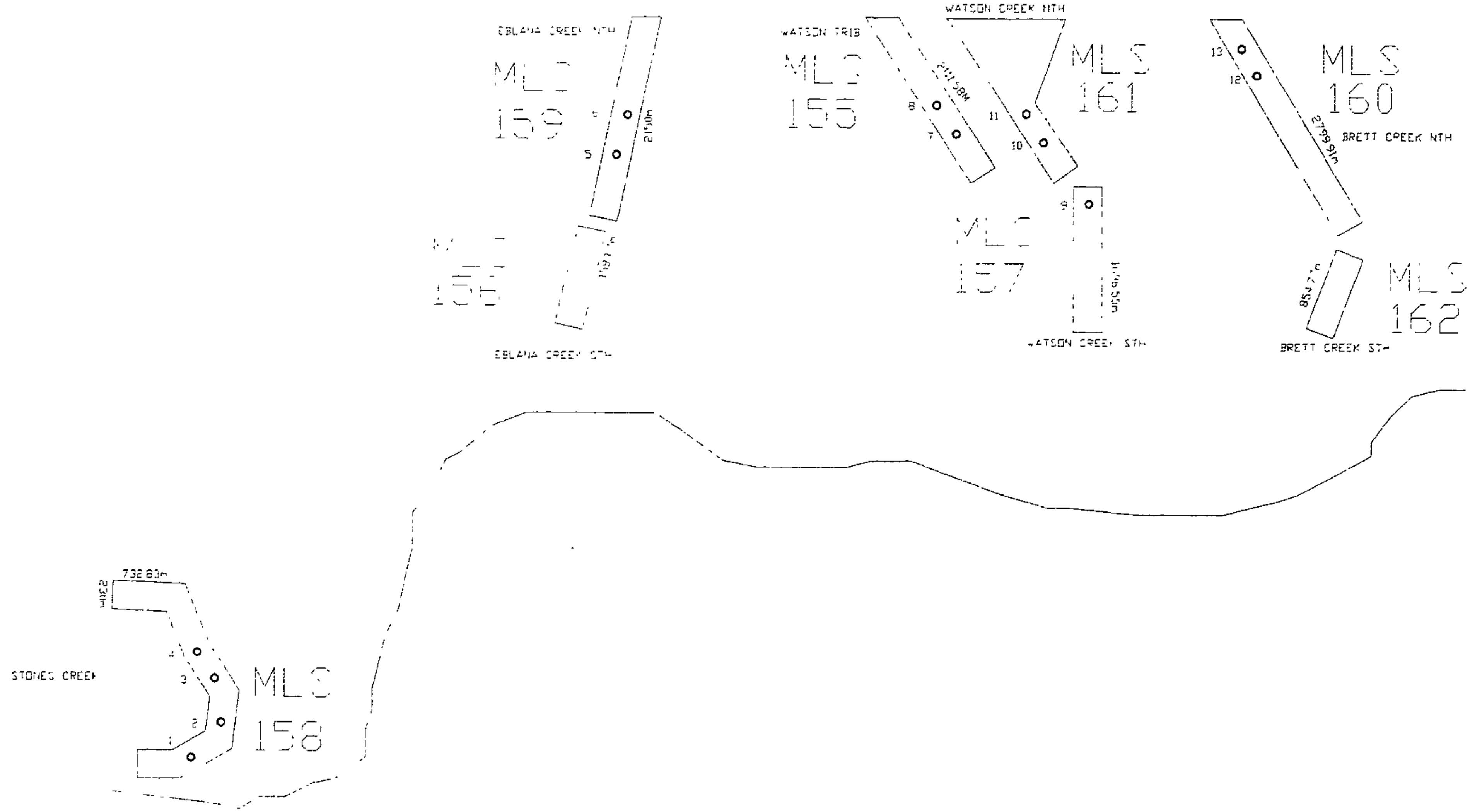
Dear Mr Jolly

I refer to your correspondence titled Annual Report to March 1997, MLS155. You refer in this report to ongoing metallurgical testing, production evaluation and testing but fail to provide the results of this work. I request that you provide a detailed report which provides the results of all tests completed and locations of samples derived. If it is simpler to report all the work on the MLS's as a project authorisation is provided. You have also failed to outline the expenditure incurred in this period as required. I request that this information be lodged by 30/6/97. Should you have any queries please contact me on 0889995355 or Maria Duchateau on 0889995283.

Yours sincerely

16.5.97
Paul Le Messurier
Chief Government Geologist

MAILED 26-5-97
RECEIVED 4-6 97



ACLTWIN NTEL LEASES	APPROX SAMPLE LOCATIONS	PRINT 24.0.160	CHAMBIGNE GARNET — NOT TO SCALE
DRAWING NUMBER			MINERAL LEASES

ANALYTICAL REPORT - SAMPLE PROCESSING FLOWSHEET

Sample Number	1	2	3	4	5	6	7	8	9	10	11	12	13
	%	%	%	%	%	%	%	%	%	%	%	%	%
+2mm O/S	22.34	8.62	8.78	3.18	6.65	7.09	14.25	10.98	0.77	2.04	4.47	4.16	6.98
U/S													
Float	42.80	61.63	53.42	61.44	72.80	81.37	70.92	77.06	85.06	78.05	73.44	76.96	84.58
Sink	34.85	29.75	37.80	35.38	20.54	11.54	14.82	11.96	14.18	19.91	22.09	18.89	8.44
	99.99	100.00	100.00	100.00	99.99	100.00	99.99	100.00	100.01	100.00	100.00	100.01	100.00
Table Conc.													
Test1													
conc	4.76	3.53	2.95	2.06	0.96	0.66	0.70	0.95	0.22	0.34	0.42	0.09	0.59
tail	3.54	3.08	6.76	2.30	0.34	0.18	0.20	0.14	0.04	0.28	0.32	0.02	0.04
Test2													
conc	3.45	3.10	3.02	3.29	1.61	0.84	1.07	0.85	0.46	1.01	0.69	0.21	0.71
tail	3.92	2.57	5.57	2.25	0.81	0.24	0.29	0.13	0.05	0.14	0.24	0.03	0.06
Test3													
conc	3.68	3.39	3.18	3.77	3.06	1.16	2.12	1.5	1.47	2.58	1.86	0.85	1.29
tail	4.16	2.99	4.77	4 25	2.18	0.64	0.82	0.24	0.19	0.43	0.56	0.10	0.11
Test4													
conc	5.02	5.88	4.83	8.51	6.08	4.18	5.51	5.89	7.55	9.98	10.17	10.58	3.11
tail	4.68	3.68	4.60	6.23	3.99	1.95	2.75	0.74	1.77	2.76	4.55	1.54	0.31
Test5													
conc	0.25	0.36	0.40	0 13	0.54	0.48	0.49	0.78	0.78	0.21	0.15	0.33	0.64
tail	1.27	1.17	1.54	2.58	0.77	1.21	0.64	0.85	1.64	2.18	3.02	5.02	1.60
	34.73	29.75	37.61	35.38	20.34	11.54	14.59	12.07	14.17	19.90	21.99	18.77	8.45

EXPENDITURE INCURRED - $800.00

COMPILATION OF CHAMBIGNE GARNET PTY LTD's RESEARCH INTO GARNET CHARACTERISATION

Garnet is a collective term for a group of naturally occurring, reasonably uncommon, rock forming minerals. Garnets, as a mineral group, have particular ranges of physical and chemical properties which can make them useful as industrial minerals. They have a common crystal habit and some similarity in chemical composition.

In the crystal chemical concept of solid solutions the crystal structure experiences no change or perturbation as long as a positively charged ion is replaced by a positively charged ion, and they have the same charge and are quite similar in ionic size or radius.

On the following page is a diagrammatic representation of the crystal structure or "unit cell" of garnet. The crystal structure is dominated by large negative oxygen ions, which occur at the corners of the lightly shaded, eight-sided polyhedra [octahedra], and at the corners of the medium shaded four-sided polyhedra [tetrahedra], but are not shown in the diagram, since they would preclude looking "into" the structure.

The positively charged metal ions, or cations, occupy three distinct sets of crystal sites.

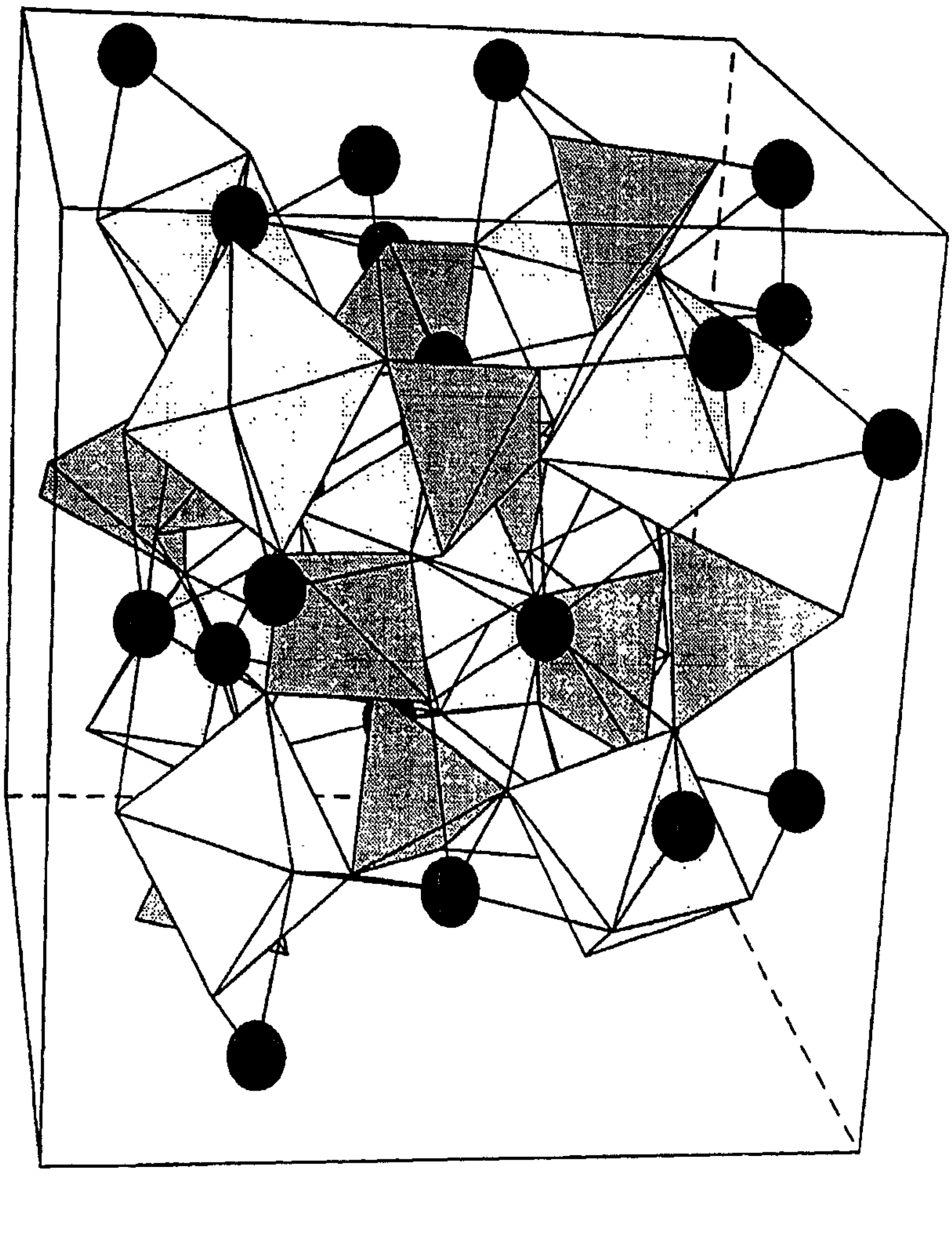
The first of these, shown as darkly-shaded spheres, are surrounded by eight nearest oxygens [eight-coordinated], and are commonly occupied by ferrous iron ions, Fe^{2+}. However, each of these sites may be occupied instead by any positively charged metal ion with the same charge, +2, and approximately the same ionic size, as the ferrous iron ion Fe^{2+}. It turns out that these three common metal ions can occupy these sites: ferrous iron, Fe^{2+}, magnesium, Mg^{2+}, and manganese, Mn^{2+}.

The second type of sites, surrounded by six nearest oxygens [six-coordinated], are located inside the lightly shaded eight-sided polyhedra, and are commonly occupied by aluminium ions, Al^{3+}. However, in place of aluminium, these sites can also be occupied by any commonly occurring positively charged metal ion, as long as it has the same charge, +3, and roughly the same ionic size as Al^{3+}. It turns out that three common metal ions can occupy these sites: aluminium, Al^{3+}, ferric iron, Fe^{3+}, and chromium, Cr^{3+}.

The third type of sites, located inside the medium-shaded four-sided polyhedra, are always occupied by silicon ions, Si^{4+}.

Since in even the most minute garnet grain there are literally billions of each of the eight-six- and four-coordinated sites, and each individual one of the first two types can be occupied by one of three metal ions, depending only on the "availability" or "concentration" of the respective ions, garnets are really solid-solutions of the six pure end-members, defined as follows:

Almandine	$Fe_3Al_2Si_3O_{12}$	[the iron here is Fe^{2+}]
Pyrope	$Mg_3Al_2Si_3O_{12}$	
Spessartine	$Mn_3Al_2Si_3O_{12}$	
Grossular	$Ca_3Al_2Si_3O_{12}$	
Andradite	$Ca_3Fe_2Si_3O_{12}$	[the iron here is Fe^{3+}]
Uvarovite	$Ca_3Cr_2Si_3O_{12}$	



In nature, all garnets are solid solutions of at least two of the above end-members. As an example, take the analysis of a particular garnet grain from the Harts Ranges. The chemical analysis of this grain can be easily reformulated to look like this:

$$[Fe_{1.8}Mg_{0.6}Ca_{0.45}Mn_{0.15}](Al_{1.9}Fe_{0.08}Cr_{0.02})Si_3O_{12}$$

[Other garnet end-members are also possible, containing less common elements such as Y and V, but these are rare, and not in concentrations to be viable as industrial minerals]

This explains why "garnet" is a collective noun, and not a single specific species. This also means that garnet from Idaho, U.S.A., will differ in composition from those from the Precambrian gneisses from India, which will differ again from those from Siberia ect. In fact, individual garnet grains in the beach sands of W.A. have a range of compositions, reflecting the different rock types from which they were derived, as do those from the Harts Ranges of N.T., and both sets, taken as composites, differ from each other.

It comes as no surprise that as the composition of a particular garnet changes (and there are six common compositional vectors along which these can change), so do its physical properties, especially magnetic susceptibility, density, and hardness. The first two of these properties are important in the processes whereby garnet grains are separated from other mineral grains in sands, and the latter two are important as the principal measure of "goodness" for garnet grains as filtering materials and as abrasives.

A host of other physical properties will change with changing composition, such as refractive index, molar volume, colour, dispersion, electrical and thermal conductivity, heat capacity, compressibility and so on, but these are of little or no consequence in present day applications.

MAGNETIC PROPERTIES

Garnets are paramagnetic - they themselves are not magnetic, and do not retain magnetism after being in a magnetic field [like permanent magnets or the mineral magnetite] - but certain types of garnets can be attracted by strong magnetic fields.

The degree to which an individual garnet grain is attracted by a strong magnetic field is almost solely determined by the amount or molecular percentage of the two iron-bearing end-members in that grain, that is, the mole fraction of almandine+andradite, as a percentage of the total.

In terms of other minerals found in various types of sands, magnetite [Fe_3O_4] is the most magnetic, and pyrrhotite [$Fe_{1-x}S$] is weakly magnetic [both are ferromagnetic]. Next comes ilmenite [$FeTiO_3$], which is the most magnetically susceptible of the paramagnetic minerals, followed by the iron-rich garnets [that is, almandine and/or andradite rich garnets]. Note however, that as a garnet's composition changes towards decreasing amounts of almandine+andradite end-members, so its magnetic susceptibility decreases.

There are numerous other minerals, which may be found in beach sands, but all are less magnetically susceptible than iron-rich garnets. Consequently, the relatively high magnetic susceptibility of iron-rich garnets is put to use in its magnetic separation from other grains. Since magnetism is a "conjugate" property to electrostatic fields inducing a current flow, it may also be possible to separate garnets in electrostatic fields.

It comes as no surprise then, that commercially available garnet concentrates all comprise fairly iron-rich garnets. No commercial garnet sands dominated by the non-magnetic garnet end-members are currently available.

DENSITY

The density or specific gravity of a particular garnet is the algebraic sum of the densities of the individual end-members that comprise that garnet, each multiplied by its mole fraction. The densities of the pure end members, in units of grams/cm^3 are as follows:

Almandine	$Fe_3Al_2Si_3O_{12}$	4.32
Pyrope	$Mg_3Al_2Si_3O_{12}$	3.58
Spessartine	$Mn_3Al_2Si_3O_{12}$	4.19
Grossular	$Ca_3Al_2Si_3O_{12}$	3.59
Andradite	$Ca_3Fe_2Si_3O_{12}$	3.86
Uvarovite	$Ca_3Cr_2Si_3O_{12}$	3.90

Garnets as a whole are more dense than the common minerals which comprise the bulk of most sand and alluvial deposits, namely quartz (2.65) and feldspars (2.55 to 2.76); they are somewhat more dense than the other common ferromagnesian minerals such as pyroxenes, amphiboles and biotite. Garnets are less dense than the opaque oxides magnetite (5.1), ilmenite (4.75), and rutile(5).

The combination of high magnetic susceptibility, coupled with relatively high specific gravity or density, allows relatively easy and clean separation of iron-rich garnets from mineral sand deposits. In fact, garnet purities exceeding 99.2% can be routinely reached, and with more effort, it is possible to attain better than 99.9% purity in some cases.

HARDNESS

The hardness of minerals is usually expressed in the Mohs scale, which is almost linear from 1 (the mineral talc) through to 9 (the mineral corundum), with each step being about twice as hard as the one before. 10 on this scale is represented by diamond, but this is many times harder than 9.

The most common mineral group, the feldspars, are 6 on this scale. The next most common mineral, which is chemically quite inert, is quartz, the principal constituent of sand deposits, and also of dust - quartz has a hardness of 7. Garnets generally range in hardness from a low of 6.5 to a high of 7.5 for almandine-rich varieties.

The Mohs scale is comparative, depending on "scratchability", and is not reproducibly quantitative. A variety of microhardness tests are available, with the capability of quantifying surface hardness of grains down to 0.2mm in diameter. For technical reasons, one of these, the Knoop microhardness, has become the defacto standard hardness tests for the abrasive blasting industry.

Comprehensive Knoop hardness ranges (since these vary from grain to grain, depending on composition) for commercially available garnet sands are not readily available. However, almandine-rich garnets from the Harts Ranges, with values from 1700 to 2000, are the hardest of known commercially available garnet sands.

- with fewer inclusions will in turn be more dense than those with many, since the inclusions are generally of lower density than the garnet

- fresh (unweathered) garnet is quite inert in both ionic and non-ionic media; garnet is resistant to most acids and many bases at moderate concentrations. Weathered and\or strongly cracked garnets may react more readily with many fluid media, since the weathering products, both on the surface and in cracks, are much more reactive than fresh garnet.

As a consequence of the above, it is evident that the proper evaluation of garnet "grade" in any one locality requires more then the determination of total garnet content and grainsize distribution alone. Complete characterisation of the product is a requirement for achieving the best financial return for the product, and for planning production.

Almandine (the company's Harts Range garnet) is a complex iron aluminium silicate and is usually red, brownish red, purplish red or black in colour. It is found in many metamorphic rocks primarily schist and gneiss.

The typical salient physical characteristics (exc. colour) of garnet are:

Crystal system: Cubic:	The rhombic dodecahedron (twelve faces) and the trapezohedron (twenty four faces) are the most common habits.
Hardness:	7.9 - 9.2 (Mohs)
Specific Gravity:	3.15 - 4.3
Lustre:	Vitreous to resinous
Refractive Index (singularly refracting):	Minimum 1.73 (Pyrope) to maximum 1.89 (demantoid)
Fracture:	Subconchoidal to uneven
Diaphaneity:	T/parent to subtranslucent

A number concentrates of various purities have been examined microscopically, to establish the physical characteristics of garnet samples collected, plus from the bulk sampling programs performed by the company.

The vast majority of creek-bed garnet grains are free of clayey coatings, or clay-filled cracks, which would leave clay films on the worked surface in abrasive blasting applications. This is important, since a number of potential garnet deposits in small creek systems close to the garnet source rocks (which are relatively "unworked"), have unacceptably high clay coatings or adhesions (predominantly in the coarsest fraction), and even with wet separation, not all of this is removed.

The garnet concentrates contain two populations of garnet - the "red" fraction, derived predominantly from the Irindina Gneiss, comprises fragments of originally larger garnet grains. These tend to yield angular, blocky grains with one or more sharp grain edges, but may occasionally contain some minor inclusion minerals.

The second garnet population comprises the “purple” or “lilac” fraction. These are expected to be less almandine rich, with correspondingly higher mole fractions of the pyrope and grossular components.

The purple garnets also tend, especially in the large size fractions, to comprise a higher proportion of unbroken grains, many of which clearly exhibit remnants of the dodecahedral faces observed in the Riddock Amphibolite source rocks and these in turn have a somewhat slightly more rounded form. On the other hand, these purple garnets are more glassy or clear, have less cracking, and are relatively inclusion free.

The proportion of red to purple garnets in virtually all of the garnet fractions, (excepting the -200u fractions, not sufficiently purified for quantitative examination), is in the approximate ratio of 7:3.