10IKC-301

TWO DISTINCT KIMBERLITE TYPES AT THE CHURCHILL DIAMOND PROJECT

Pamela Strand[1], Anetta Banas[2], Jennifer Burgess[3], Mike Baumgartner[4]

[1] *Shear Diamonds Ltd., Toronto, ON, Canada,*
[2] *APEX Geoscience Ltd., Edmonton, AB, Canada,*
[3] *Burgess Diamonds, Sechelt, BC, Canada,*
[4] *Mineral Services Canada, North Vancouver, BC, Canada*

Introduction

The Churchill Diamond Project is a well established, expanding kimberlite field that was discovered in 2003 by Shear Minerals Ltd. (now Shear Diamonds Ltd.), as operator, and partners. The project had its origin in a conceptual idea in 2001 and grew to be one of the largest drill programs for diamonds in Canada. To date 88 kimberlites have been discovered on the property, including 11 highly diamondiferous kimberlite dykes (Kahuna, PST, Notch, Jigsaw and others). The project is located between the communities of Rankin Inlet and Chesterfield Inlet in Nunavut, Canada (Figure 1).

Figure 1: Location map. Modified after Berman et al., 2007.

Geological Setting

The property is underlain by rocks of the metamorphosed Archean Rankin Inlet group and surrounded by Archean metaplutonic rocks of the Churchill Structural Province of the Archean Canadian Shield (Figure 1; Hoffman, 1990).

The Quaternary geology of the region is dominated by glaciation associated with the Laurentide ice sheet flowing in a southeasterly direction (McMartin, 2000).

Surficial deposits are dominated by till mounds with segregated glaciofluvial deposits found throughout the southern part of the property and marine reworked deposits along the Hudson Bay coast. Detailed knowledge of the Quaternary geology has been a fundamental part of the planning and execution of the till sampling exploration program and in understanding the results thereof (Strand et al., 2010).

Exploration History

Through an extensive sampling program, completed between 2002 and 2010, over 10,000 till samples have been collected on the property. Samples contain a full suite of indicator minerals, including high-Cr peridotitic garnet, low-Cr eclogitic/pyroxenitic/megacryst garnet, chrome diopside, Mg-chromite, picro-ilmenite and olivine. Two high priority indicator mineral corridors - the Josephine River ('JR') and Sedna corridors - have been identified (Figure 2). The high abundance of indicator minerals with favorable compositions – especially the presence of high-Cr G10 pyropes - has driven exploration in the area.

The property has been extensively covered by regional and detailed airborne and ground geophysical surveys. Between 2003 and 2005, numerous geophysical targets were identified and the majority of those that were selected for drilling proved to be kimberlite pipes. However, these kimberlites had indicator mineral compositions which did not coincide with the high interest compositions recovered from the till samples and were either very weakly diamondiferous or barren of microdiamonds. In 2006, prospecting in areas with high interest garnet compositions

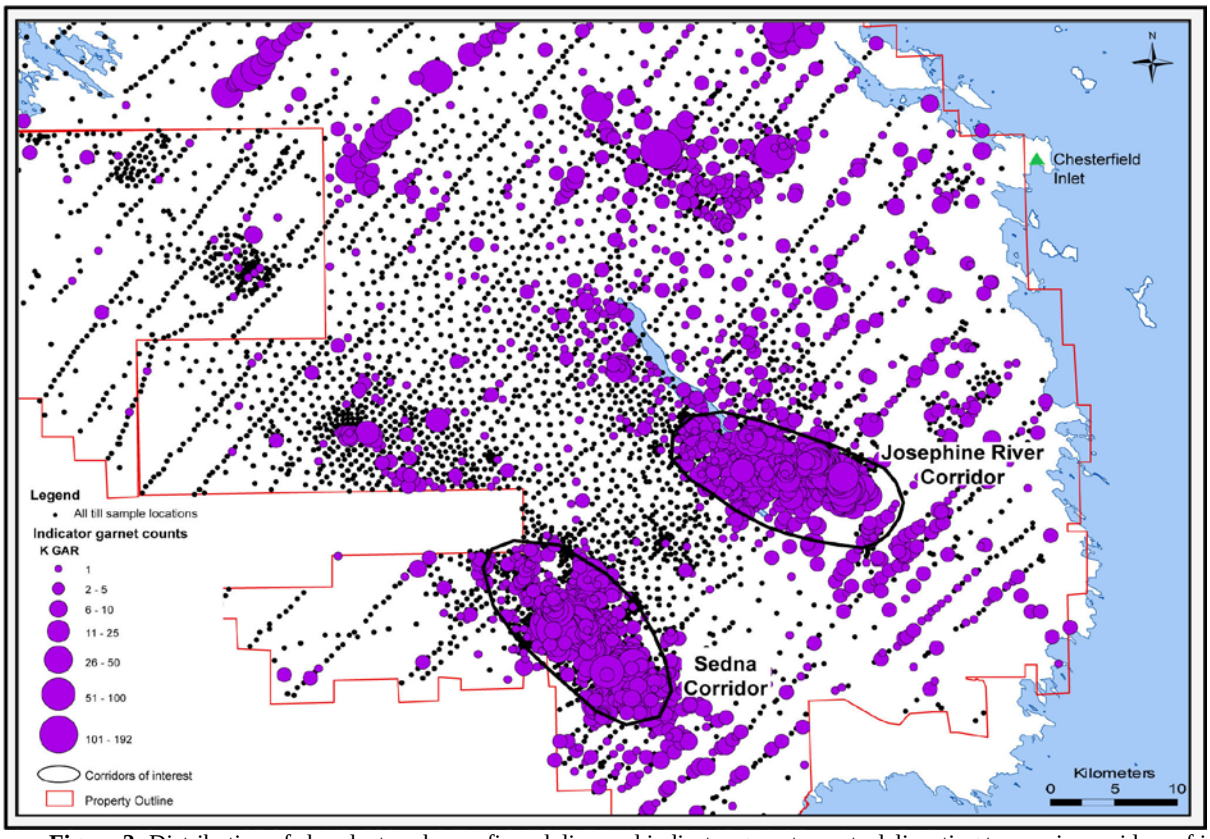

Figure 2: Distribution of abundant probe confirmed diamond indicator garnet counts delineating two main corridors of interest.

led to the discovery of a second kimberlite type with similar high interest indicator mineral compositions to those recovered from till samples. Subsequently, field prospecting and drilling has resulted in the discovery of an additional 10 kimberlites with similar characteristics, all of which are highly diamondiferous. The two discrete types of kimberlites on the Churchill property have been termed Type A (low interest) and Type B (high interest).

Kimberlite Characterization

Type A

Type A (low interest) kimberlites are characterized by strong magnetic signatures readily identified from airborne geophysical surveys. The kimberlites are identified by both discrete pipe-like and linear (dyke-like) geophysical signatures. The maximum intensity observed for Type A kimberlites is -1500 nT, with the average intensity of approximately ±500 nT measured from an airborne platform at ~30 m height. The Type A kimberlite pipes/dykes identified to date have both magnetic high and magnetic low signatures.

The Type A kimberlites are fine grained with dominantly magmatic textures, contain rare to absent olivine macrocrysts, and commonly contain large olivine phenocrysts (Figure 3). Mineralogically Type A kimberlites fall in a range that can be classified as magmatic sparsely macrocrystic oxide-rich calcite kimberlite, to magmatic macrocrystic oxide-rich monticellite phlogopite kimberlite, to a magmatic highly evolved serpentine kimberlite (Zurevinski et al., 2008).

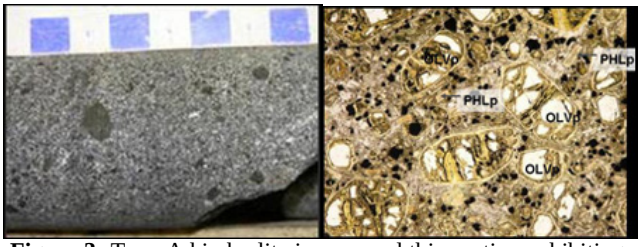

Figure 3: Type A kimberlite in core and thin section exhibiting common large olivine phenocrysts (OLVp) and phlogopite phenocrysts (PHLp).

The Type A kimberlites contain low abundances of indicator minerals. Usually recoveries of indicator minerals from the Type A kimberlites number less than 50 indicator

minerals per kilogram of kimberlite processed. The indicator minerals are dominated by ilmenite and contain rare garnet. The garnets have compositional trends suggesting low diamond potential. Based on clinopyroxene xenocrysts a geothermal gradient of ~40-41 mW/m^2 was modeled for the Type A kimberlites. They have emplacement ages between 170 and 228 Ma. Seventy-seven kimberlites (pipes and dykes) of this type have been discovered to date.

Type B

In contrast, Type B (high interest) kimberlites are characterized by subtle magnetic signatures. The signatures are usually not evident on the 'regional' - 150 and 75 m spaced - airborne geophysical survey data but become evident on target specific ground geophysical grids and on high-resolution airborne data. The maximum intensity observed for Type B kimberlites is 125nT, with the average intensity of approximately 25-75nT, based on ground profiles. To date the Type B kimberlites have magnetic high signatures only.

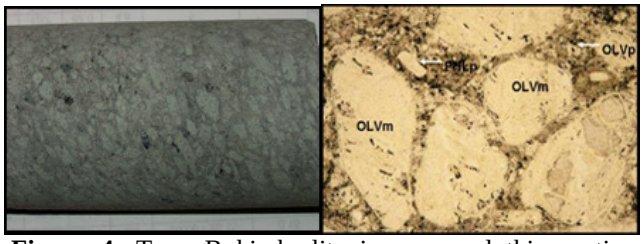

Figure 4: Type B kimberlite in core and thin section exhibiting common olivine macrocrysts (OLVm), olivine phenocrysts (OLVp) and phlogopite phenocrysts (PHLp).

Type B kimberlites are magmatic, medium to coarse-grained, and contain two generations of olivine, including abundant olivine macrocrysts (Figure 4). Mineralogically the Type B kimberlites can be classified as monticellite to monticellite phlogopite kimberlite.

These kimberlites contain abundant indicator minerals as indicated by the recovery of greater than 200 indicator minerals per kilogram of kimberlite processed, with recoveries as high as 1500 indicator minerals per kilogram. The indicator minerals contain a low abundance of ilmenite and a high abundance of garnet. Both of these minerals have prospective compositions. Based on clinopyroxene xenocrysts a lower geothermal gradient of ~37 mW/m^2 has been calculated for these bodies. Dating of the Type B kimberlites consistently results in an isochron age of 234 Ma. Eleven Type B kimberlite dykes have been discovered to date.

Contrasting Indicator Mineral Compositions

Detailed analysis of the indicator mineral compositions was integral to the recognition that two types of kimberlites existed in this area. The initially discovered Type A kimberlites did not reflect the highly encouraging indicator mineral abundances and compositions found in many of the till samples (>27% G10). The garnets recovered from the Type A kimberlites are characterised by high-Ca G9 compositions which are distinctly offset from the G9/G10 line (Figure 5; Gurney, 1984). Representative electron microprobe analyses of garnet recovered from the two kimberlite types are presented in Table 1.

In contrast to the Type A kimberlites, the Type B kimberlites show significant overlap with the high interest compositions recovered from the till samples. The garnets from Type B kimberlite are characterized by common Cr-rich G10 pyropes and low-Ca G9 pyropes which plot close

Rock MinchemID	Kimberlite Type	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO (total)	MgO	MnO	CaO	Na_2O	Oxide Total
9801	B	40.6	0.05	16.0	10.65	7.2	20.8	0.44	3.64	0.03	99.51
10082	B	41.8	0.27	20.2	4.37	7.8	20.4	0.35	4.55	0.06	99.80
8695	B	40.8	0.07	17.0	9.24	7.1	19.4	0.39	5.80	0.04	99.86
8668	B	40.4	0.52	14.5	11.38	7.6	18.1	0.42	6.87	0.07	99.82
8717	B	41.3	0.07	18.0	7.94	7.2	20.9	0.41	3.89	0.03	99.80
987	A	42.1	0.58	22.1	1.33	9.7	19.4	0.30	4.62		100.03
339	A	41.6	0.50	16.9	8.43	6.7	18.9	0.25	6.56		99.73
1028	A	41.7	0.27	22.3	1.31	12.4	17.0	0.53	4.69	0.05	100.31
6331	A	42.1	0.21	20.6	4.67	6.5	20.3	0.29	5.90		100.53

Table 1: Representative electron microprobe analyses of garnet recovered from the two kimberlite types.

to the G9/G10 line (Table 1). These compositions have been associated with derivation from within the diamond stability field (Figure 6; Grütter and Menzies, 2003).

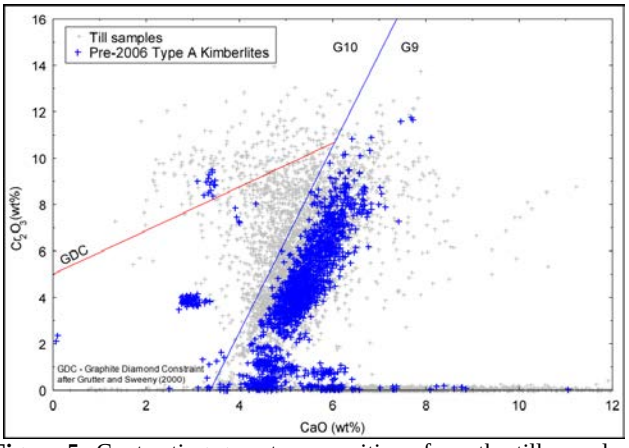

Figure 5: Contrasting garnet compositions from the till samples versus the Type A kimberlites. GDC – Graphite Diamond Constraint after Grutter and Sweeney, 2000.

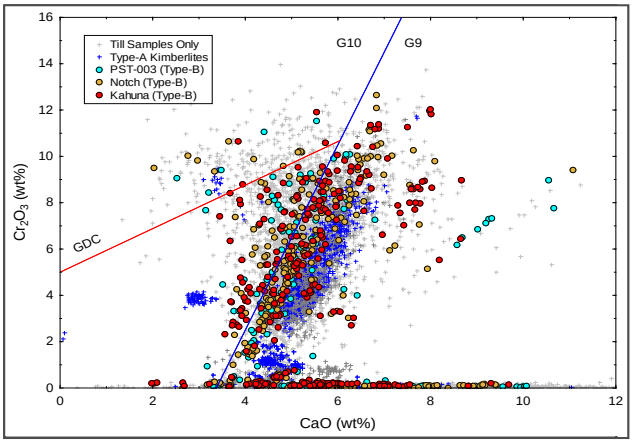

Figure 6: Contrasting pyrope compositions from the till samples versus the Type A and Type B kimberlites. GDC – Graphite Diamond Constraint after Grutter and Sweeney, 2000.

The presence of two distinct thermal regimes was first identified in temperature and pressure profiles established for the peridotitic garnets recovered from the till samples. The presence of "low" geotherm peridotitic garnets was key to the discovery of the first Type B kimberlites.

Comprehensive analysis of the oxides has also shown the presence of two ilmenite populations. Ilmenite associated with the high interest Type B kimberlite has higher MgO and Cr_2O_3 and lower TiO_2 and Al_2O_3 than ilmenite from the low interest Type A bodies.

Implications for Diamond content

In accordance with their petrographic classification and indicator mineral compositions, the low interest kimberlites have negligible diamond contents whereas the high interest kimberlites are significantly diamondiferous. Grades obtained from bulk sampling and drilling of the Type B kimberlites vary from 0.49 cpt (carats per tonne) for Jigsaw to 2.18 cpt for the PST kimberlite (Figure 7). A summary of the diamond grades and kimberlite dimensions is presented in Table 2. The longest and widest of the Type B dykes, the Kahuna kimberlite, has a grade of 1.04 cpt. The largest diamond recovered on the property is from the Kahuna kimberlite. The diamond weighs 5.43 carats and is a broken fragment of a larger stone. It is estimated from the recovery of eight complementary broken diamonds in the same sample to have been up to 14 carats in size.

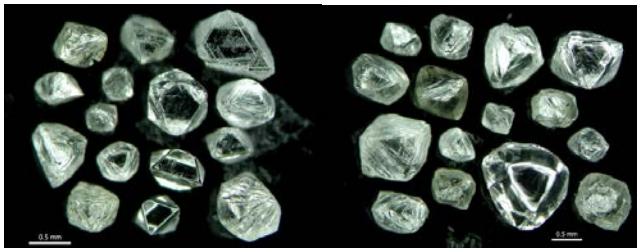

Figure 7: Diamonds from the Notch (left) and PST (right) kimberlite mini-bulk samples.

Kimberlite Body name	Body Type	Grade (Carats Per Tonne) for diamonds >0.85mm	Tonnes processed to date	Weight of Diamonds Recovered	Width (m)	Length (m)	Deepest Drill Intersection (metres below surface)	Dip (degrees)
PST 003	Dyke	2.18	3.55	7.72	0.8	150	53.9	Vertical
Kahuna	Dyke	1.04	356	336.69	3.5 - 4	5,500	151.6	Vertical
Notch	Dyke	0.862	17.26	14.87	1.5	3,000	79.5	Vertical
North Notch	Dyke	0.8	0.5	0.4	n/a	n/a	n/a	Vertical
Jigsaw	Dyke	0.49	5.15	2.53	1.3	1,000	n/a	Vertical

Table 2: Statistics for the key Type B kimberlites on the Churchill Project based on drilling and bulk sampling.

Conclusions

Diligent analysis of the abundance and compositions of indicator minerals in till samples has led to the discovery of two types of kimberlites on the Churchill Diamond Property. This has required looking beyond geophysical signatures to find highly diamondiferous kimberlites that are the source of the high interest mineral compositions recovered from the till samples. Future exploration programs will be focused on resolving the source of the many unsourced dispersions containing high interest mineral compositions and locating larger tonnage kimberlites. A diamond valuation on the Kahuna and Notch diamond parcels recovered from the bulk samples will be completed. Exploration continues…..

Acknowledgements

This project would not be possible without the participation of many contributors: our partner Stornoway Diamond Corporation, and former partner BHP Billiton; the laboratories (incl. SRC & Mineral Services) on whom we rely on for timely data; all our project crew and support staff that have dedicated large amounts of their time to be in the field, during good and bad weather; as well as Kit Campbell and Herman Grütter; finally all the shareholders that fund and support diamond exploration as it grows as one of the newest chapters in Canadian mining.

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