Assessment Report for the

Toby Creek Area Claims

Golden Mining Division
N.T.S. 82 K/8W
Latitude 50°28' N, Longitude 116°23' W

for

Nihilist Corporation
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Calgary, AB
T2J 1M8

Submitted by:


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Submitted: September 17th, 1998

GEOLOGICAL SURVEY BRANCH
ASSessment REPORT

25,658
SUMMARY

Alkaline diatremes are located in three broad areas, namely the Rocky Mountain Alkaline Belt, the Goat River area of the southern Purcell Mountains and in a north-south belt straddling Toby Creek, west of Invermere. Substantial literature is available on the Rocky Mountain localities in the form of Assessment Reports, BCMEMPR papers, open files/maps, and GSC reports/maps. Despite the amount of literature, it is the author's opinion that the diatremes have not been adequately evaluated for diamond potential, particularly with regard to recent models for new prospective environments. Although widely used, the South African model may not be the best model for western Canadian exploration, particularly in the Cordillera.

Alkaline intrusive diatremes, dykes and sills have been documented in the north-south trending Rocky Mountain Alkaline Belt (RMAB). Lithologies include olivine melilitites, limburgites, alkaline to basaltic lamprophyres, kimberlites and diamond-bearing lamproites, although the lithology of these diamond-bearing occurrences has been disputed. The Cross kimberlite is a Permo-Triassic intrusive breccia located on the southeastern edge of the RMAB. The Joff Pipe is located on the western edge of this same belt east of Invermere and is considered to be either a kimberlite or an olivine melilitite. The northern portion of this belt is located west of the Columbia Icefields and consists of diamond-bearing lamproites, now interpreted to be lamprophyres. Of particular significance regarding this program is the presence of diamond-bearing lithologies in a mobile belt.

Diatreme occurrences in the Rocky Mountains, in general, have silica deficient compositions, are potassium-enriched (to ultra-potassic) and have high MgO and TiO$_2$ contents. Mineralogically, they contain olivine (partially to completely altered to calcite and/or serpentine), clinopyroxene (as xenocrysts and/or phenocrysts), orthopyroxene, feldspathoids (including nepheline, melilite, leucite and sodalite) and spinels (chromite). Kimberlite indicator minerals have been found throughout the RMAB in many occurrences. One widely recognized kimberlite (Crossing Creek) has been identified and documented while another (Joff - Shatch Mountain) has been identified as both a kimberlite and as an alkaline lamprophyre (olivine melilitite) by different authors. Emplacement ages interpreted for other occurrences, based on intrusive relationships, are as follows: Ordovician - Silurian, Devonian - Mississippian and Permian - Triassic. Geochronological evidence determined to date support these proposed periods of alkaline, ultrapotassic intrusive activity.

One true kimberlite and at least twelve dykes of kimberlitic affinity have been documented in the Purcell Mountains, west of Invermere. They have been dated at $245 \pm 2.4$ Ma and are therefore coeval with the Cross kimberlite at the southern end of the RMAB ($241 \pm 5$ Ma and $249 \pm 12$ Ma; $244$ Ma). Mineralogically, texturally and compositionally, the Goat River alkaline occurrences are similar to occurrences in the Toby Creek area. Other diatremes have been documented elsewhere (Pell 1994, 1987, Grieve 1981). The claims documented in this report were staked to cover silica-deficient, potassium-enriched occurrences, having xenolithic textures (including sedimentary, lower crustal and possibly mantle inclusions), large megacrystic
and euhedral phlogopites in a carbonatized and chloritized igneous matrix. Mineralogically, they may contain pseudomorphed olivine (altered to calcite or serpentine), euhedral to subhedral phlogopite phenocrysts to macrocrysts, ilmenite and apatite. Furthermore, they reportedly contain a minor component of ultramafic inclusions and foreign xenoliths. The extensive alteration resulting in serpentine and carbonate pseudomorphed phenocrysts with euhedral to subhedral megacrysts of phlogopite is common among these occurrences.

One diatreme in the Goat River area has been dated by Cominco and returned a K-Ar age of 301 ± 10 Ma. In addition, age dates have been determined on the Cross Kimberlite and the Toby kimberlite. None of the other diatremes have been dated. Therefore, it has not been possible to determine a conclusive emplacement age for the diatremes beyond the fact that they intrude host strata and, in some cases, underlie unconformities imposing some constraint on emplacement age. The Goat River occurrences have features similar to the Toby Creek occurrences which suggests an affinity and possibly a broadly coeval emplacement ages. The Toby Creek kimberlite has been dated at 245 ± 2.4 Ma and it is hereby proposed that this might be a reasonable age for the Goat River occurrences.

The presence of the Goat River occurrences in the southern Purcell Mountains, south of dykes having kimberlitic composition in the Toby Creek area suggests the possibility of a second alkaline belt in the Purcell Mountains, west of the well documented RMAB. The Toby Creek area dykes occur as rusty weathering, variably carbonatized intrusive bodies ranging from 50 centimetres to 10 metres thick. They have narrow chilled margins and show little or no evidence of contact metamorphism with either host lithologies or xenoliths. The dykes are xenolithic and include pyroxenite nodules. The occurrences have been subdivided into two suites based on petrology and chemistry. Group A were considered to be lamprophyres having kimberlitic affinity whereas Group B were considered to be true kimberlites.

The diatremes have features consistent with steeply cross-cutting diatremes elsewhere in BC. These features include: lack of thermal alteration of inclusions, wide variety of xenoliths which include host lithologies, crustal and possible mantle inclusions, large xenocrysts / megacrysts of phlogopite and limited areal extent.

Diatremes in the southern Rocky Mountains are interpreted to have been intruded predominantly in the early Paleozoic yet contain zircon xenocrysts of Archean to early Paleozoic age. Crustal-type xenoliths are documented from several of the occurrences as well as mantle-derived xenoliths such as pyroxenites, peridotites and eclogites. In addition to abundant indicator minerals, micro-diamonds have been recovered from heavy mineral separates from the Jack and Mark diatreme occurrences northeast of Golden and macro-diamonds from the ICE property northwest of Elkford. Although these diatremes are contained within a Paleozoic mobile belt, recent geophysical programs have identified underlying Proterozoic and Archean basement. More significant is recent identification of a large composite block of Archean craton, part of the Hearn Province, in southern Alberta which underlies eastern British Columbia.
The basement of the Alberta Basin has been correlated to exposures of the Canadian Shield using U-Pb age determinations of basement material from drill core and aeromagnetic signatures. Canadian Shield exposures have been correlated from Saskatchewan and Northwestern Alberta to southwest trending aeromagnetic anomalies in the subsurface of Alberta. Furthermore, these anomalies can be correlated with confidence to the basement underlying the Cordillera and support the interpretation that North American cratonic basement underlies the Rocky Mountains, Rocky Mountain Trench and eastern part of the Purcell Mountains. Finally, exposures of basement gneiss in the southern Cordillera demonstrate the presence of Proterozoic and Archean basement underlying miogeoclinal strata west of the Rocky Mountain Trench.

Diamonds have been recovered from at least four alkalic diatremes located in a Paleozoic mobile belt, tectonically emplaced upon Archean and Proterozoic basement. Diatremes of the southern Cordillera appear to have intruded a composite Archean cratonic block correlated to the Hearn Province. The Rocky Mountains are underlain in this area by Archean basement for which an age of 2.6 to 3.2 billion years has been determined, consistent with the ages of periodotitic diamonds determined world-wide (3.3 billion years). It is therefore reasonable to expect the presence of diamonds with mantle-derived peridotitic/eclogitic nodules and zircons of Archean age.

Preliminary geochemical results of samples taken from several of the occurrences confirm a potassic to ultrapotassic, mafic to ultramafic affinity. Furthermore, ultramafic nodules (pyroxenite and eclogite) and abundant kimberlitic indicator minerals have been reported from several of the occurrences. At present, it is not clear where these intrusives originated relative to the diamond stability field. However, it is particularly significant that the diamond-bearing lamprophyres north of Golden restore palinspastically outboard of the Crossing Creek kimberlite occurrence, from which diamonds have also been recovered.

Recent mapping in the Toby Creek area of the central Purcell Mountains has identified a local basement high, the Windermere High, consisting of an inverted, dismembered high standing block of terraced basement which may have controlled emplacement of ultra-potassic dykes. These intrusive dykes define a broad north-south belt spatially associated with the intersection of the Nelson Creek Fault and the Bruce Creek Synform. The ultra-potassic dykes are kimberlitic in composition or of kimberlitic affinity. They have compositions that plot in rift associated and/or active orogen fields of ultra-potassic, major element discrimination diagrams and are coeval with the Cross kimberlite in the southern Rocky Mountains at 245 ± 2.4 Ma.

The common petrogenesis and extensional, fault controlled structural setting, coupled with essentially identical ages of emplacement suggests the Toby Creek occurrences and Cross kimberlite had a coeval evolution during a single phase of continental extension. Ultramafic occurrences in the Goat River area represent a newly discovered series of ultra-potassic occurrences in an area previously thought devoid of such intrusives. They are exciting in terms of their possible kimberlitic affinity and relationship with diamond-bearing occurrences in the
southern Rocky Mountains. In summary, with documented recovery of micro- and macro-
diamonds from alkaline diatremes lying within a well defined alkaline belt overlying an Archean
cratonic block, there is a very strong rationale for continued exploration for, and evaluation of,
alkaline diatremes in southern BC. Furthermore, unsuccessful evaluation in the past for
diamond potential relied exclusively on a South African model. Recent work has shown that
other models may be more applicable to occurrences in the southern Cordillera (i.e. ophiolitic
diamonds in Nepal and Spain, alkali basalt and nephelinite hosted diamonds in New South
Wales, Australia and lamproitic hosts such as the Argyle Mine, Australia)

The program to date has emphasized acquisition of potential diamond-bearing properties in the
Rocky and Purcell Mountains for subsequent evaluation. A cursory geological examination has
been conducted on the claims described in this report, comprised of prospecting in an attempt to
identify additional diatreme occurrences. Dykes and other occurrences previously described on
the claims were briefly inspected, but the emphasis of the limited program was to identify new
occurrences and / or additional exposures of known exposures. One day was spent utilizing a
helicopter to facilitate access of the Alpine (Sultana Creek), Bruce (Creek) and C12 (Law Creek)
ocurrences, however unexpected, persistent late season snow limited the effectiveness of
prospecting.
# Table of Contents

<table>
<thead>
<tr>
<th>Summary</th>
<th>i</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Diamond Exploration Potential</td>
<td>4</td>
</tr>
<tr>
<td>Location and Access</td>
<td>6</td>
</tr>
<tr>
<td>Physiography and Climate</td>
<td>6</td>
</tr>
<tr>
<td>Claim Status</td>
<td>7</td>
</tr>
<tr>
<td>History</td>
<td>13</td>
</tr>
<tr>
<td>Mineral King Mine</td>
<td>13</td>
</tr>
<tr>
<td>Kootenay Queen Group</td>
<td>13</td>
</tr>
<tr>
<td>Silver Queen Mine</td>
<td>13</td>
</tr>
<tr>
<td>Silver Spray Mine</td>
<td>14</td>
</tr>
<tr>
<td>Pretty Girl Group</td>
<td>14</td>
</tr>
<tr>
<td>Regional Geology</td>
<td>15</td>
</tr>
<tr>
<td>Stratigraphy</td>
<td>15</td>
</tr>
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<td>Proterozoic</td>
<td>15</td>
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<td>Belt-Purcell Supergroup</td>
<td>15</td>
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<td>Windermere Supergroup</td>
<td>17</td>
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<tr>
<td>Lower Paleozoic</td>
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<td>Permo-Triassic</td>
<td>19</td>
</tr>
<tr>
<td>Structure</td>
<td>21</td>
</tr>
<tr>
<td>Local Geology</td>
<td>22</td>
</tr>
<tr>
<td>1997-98 Program</td>
<td>24</td>
</tr>
<tr>
<td>Results</td>
<td>25</td>
</tr>
<tr>
<td>Conclusions and Recommendations</td>
<td>29</td>
</tr>
<tr>
<td>Proposed Budget</td>
<td>30</td>
</tr>
<tr>
<td>References</td>
<td>31</td>
</tr>
</tbody>
</table>
List of Figures

Figure 1 - Regional Location Map ................................................................. 2
Figure 2 - Regional Geology Map ................................................................. 3
Figure 3a - Regional Claim Map ................................................................. (in pocket)
Figure 3b - Alpine Claim Map ................................................................. 8
Figure 3c - ANNE Claim Map ................................................................. 9
Figure 3d - BRUCE / C12 Claim Map ..................................................... 10
Figure 3e - SUL Claim Map ................................................................. (in pocket)
Figure 4 - Geological Map (1:50,000) ..................................................... (in pocket)
Figure 5 - BRUCE / C12 Geology Map .................................................. (in pocket)
Figure 6 - SUL Geology Map ................................................................. (in pocket)

List of Tables

Table 1: Whole rock chemistry for ultrabasic - ultra-potassic dykes in the
Toby - Horsethief Creek area ................................................................. 20

List of Appendices

Appendix A - Statements of Qualification
Appendix B - Claim Records
Appendix C - Statement of Expenditures
Appendix D - Program - Related Documents
INTRODUCTION

Diatremes in the southern Cordillera (Fig. 1 and 2) are interpreted to have been intruded predominantly in the early Paleozoic yet contain zircon xenocrysts of Archean to early Paleozoic age. Crustal-type xenoliths are documented from many of the pipes (eg. Blackfoot, Summer, Cross and HP) as well as mantle-derived xenoliths such as pyroxenites, peridotites and eclogites (Pell 1994). In addition to abundant "indicator minerals", at least 10 micro-diamonds have been reported and at least three recovered from heavy mineral separates from diatreme occurrences northeast of Golden, BC. Dia Met Minerals Ltd. further reports recovery of two macro-diamonds from the Mark and Jack diatremes.

Although these diatremes are contained within a Paleozoic mobile belt, recent geophysical programmes have identified underlying Proterozoic and Archean basement. More significant is recent identification of a large composite block of Archean craton, part of the Hearn Province, in southern Alberta which projects into eastern British Columbia (Ross et al. 1991).

The basement of the Alberta Basin has been recently correlated (Ross 1991) to stratigraphic and/or structural provinces identified in the Canadian Shield (Hoffman 1988), using U-Pb age determinations of basement exposures from drill core and aeromagnetic signatures (Ross et al. 1991). Exposures of basement gneisses in the southern Cordillera coupled with numerous other studies (eg. lithoprobe deep reflection seismic studies; geochronological and isotopic studies; aeromagnetic, gravity, and seismic refraction studies) demonstrate the presence of Proterozoic and Archean basement underlying miogeoclinal strata west of the Rocky Mountain Trench. Canadian Shield exposures have been correlated from Saskatchewan and northwestern Alberta into the subsurface of Alberta. These "northeast-trending anomalies... can be traced into the Cordillera and support the interpretation that North American cratonic basement projects westward beneath the Rocky Mountains, Rocky Mountain Trench and eastern part of the Purcell Anticlinorium" (Cook et al. 1991). Lithoprobe deep seismic reflection data has "... imaged a regionally extensive, west-facing transition (on the west side of the Monashee Mountains) from thick craton on the east to thin transitional, basinal or oceanic crust on the west..." (Cook et al. 1991).

The presence of Proterozoic and Archean basement beneath the Cordillera has been interpreted based on many complementary lines of evidence. Ross et al. (1991) have correlated gneisses of the Canadian Shield with basement gneisses of the Alberta Basin while others (Armstrong et al. 1991, McDonough and Parrish 1991, Murphy et al. 1991, Parkinson 1991) have proposed a Canadian Shield origin for basement gneiss exposures in the Canadian Cordillera. Therefore, Canadian Shield gneisses extend into the subsurface of the Alberta Basin and extend beneath the Cordillera to at least the west edge of the Monashee Mountains, where transitional crust is interpreted to occur.

Therefore, diamonds have been recovered from two alkalic diatremes located in a Paleozoic mobile belt. The mobile belt consists of thrust sheets tectonically emplaced upon Archean and
Proterozoic basement. Diatremes of the southern Cordillera appear to have intruded a composite Archean cratonic block correlated to the Hearn Province. Zircons recovered from diatremes in the Rocky Mountains have been interpreted as having been sourced, in part, from the mantle. It is therefore reasonable to expect the presence of diamonds with mantle-derived peridotite/eclogite nodules and zircons of Archean age.

**Diamond Exploration Potential**

Diatremes in the Rocky Mountains have silica deficient compositions, are potassium enriched, and have high MgO and TiO₂ content. Mineralogically, they contain olivine (partially to completely altered to calcite or serpentine), clinopyroxene (as xenocrysts and probably as phenocrysts), orthopyroxene, feldspathoids (including nepheline, melilitie, leucite and sodalite) and spinels (chromite). "Kimberlite indicator minerals" have been found throughout the alkaline belt in many occurrences. One widely recognized kimberlite (Cross Creek) has been identified and documented while another (Joff - Shatch Mountain) has been identified as both a kimberlite and as an alkaline lamprophyre (olivine melilitie).

Diatremes, dykes and sills of lamproitic composition have been described at the northern end of this belt, west of the Columbia Icefields and northeast of Golden, B.C. (Ijewliw and Schulze 1988). Several diamonds have reportedly been recovered from these lamproitic occurrences (JACK claims, 1 microdiamond and 1 macrodiamond recovered; MARK claims, 1 micro-diamond recovered; Nassichuk et al. 1989) although not in economic quantities. However, diamonds have been recovered from ultra-potassic occurrences in the southern Rocky Mountains, a mobile belt.

The Cross kimberlite is near the southern end of this belt of alkaline diatremes documented in the Rocky Mountains (Pell 1986, Ijewliw 1986, Helmstaedt et al. 1987, Ijewliw and Schulze 1988, Nassichuk et al. 1989) and has been dated using several methods (241 ± 5 Ma and 249 ± 12 Ma, Smith et al. 1988; 244 Ma, Grieve 1982). Emplacement ages have been estimated for other diatremes based on intrusive relationships and three intrusive episodes have been postulated: Ordovician-Silurian, Devonian-Mississippian and Permian-Triassic (Pell 1987). Supporting data has recently been published for kimberlitic lamprophyres and kimberlite in the Purcell Mountains west of Invermere. An emplacement age of 245 ± 2.4 Ma was determined for a kimberlite immediately north of Toby Creek (Pope and Thirlwall 1992).

The Toby Creek area claims (Fig. 2) were staked on the basis of a recent scientific paper describing occurrences of kimberlite and lamprophyre dykes having a kimberlitic affinity in an entirely new location. Pope and Thirlwall (1992) document thirteen occurrences with whole rock and trace element data for 9 of these localities. The described occurrences are comprised of ultra-potassic, silica-deficient, phlogopite-apatite ultrabasic dykes that compare favourably with world-wide kimberlitic data (Dawson 1980).

The dykes are distinct from other igneous lithologies in the area which include the Toby
volcanics (altered submarine basalts), metadiabase dykes (coeval with Toby Volcanics) and the Horsethief Creek quartz monzonite batholith. Sedimentary strata in the area consist of Proterozoic to Lower Paleozoic clastics and carbonates deposited on attenuated basement of the North American miogeocline. Recent mapping (Reesor 1973, Root 1983, Pope 1990) has identified a local basement high, the "Windermere" High", consisting of an inverted, dismembered high standing block of terraced basement which may have controlled emplacement of the ultra-potassic dykes (Pope and Thirlwall 1992).

The ultra-potassic dykes are kimberlitic in composition or of kimberlitic affinity. They have compositions that plot in rift associated and / or active orogen fields of ultra-potassic, major element discrimination diagrams (Pope and Thirlwall 1992). They are coeval with the Cross kimberlite in the southern Rocky Mountains and may be spatially and temporally related to diamond-bearing ultra-potassic lamproites northeast of Golden, B.C.

Dykes in the Toby - Horsethief Creek area represent a newly discovered series of ultra-potassic occurrences in an area previously thought devoid of such intrusives. They are exciting in terms of their kimberlitic composition or affinity and possible relationship with diamond-bearing lamproites in the southern Rocky Mountains.

The presence of dykes (and possible pipes) having kimberlitic compositions in a previously unknown location together with alkaline occurrences in the Rocky Mountain Alkaline Belt (RMAB) which include lamproite and kimberlite, recovery of kimberlite indicator minerals, recovery of micro- and macro-diamonds, all of which are underlain by basement of Archean age is sufficient to warrant further exploration in the Toby - Horsethief Creek area to:

1) determine the diamond potential of these occurrences using an integrated exploration program including:
   a) soil sample geochemistry,
   b) whole rock geochemistry,
   c) heavy mineral and xenolith inclusion suites, and
   d) identification of kimberlitic indicator mineral suites, and
   e) mineral chemistry of indicator minerals identified.

2) identify additional occurrences of alkaline intrusives through detailed mapping, prospecting and remote sensing, and

3) determine the possible presence and location of hidden diatremes in subsurface or under cover using geophysics.
LOCATION AND ACCESS

The Toby Creek area claims are located in the Purcell Mountains (latitude 50°28' N, longitude 116°23' W), approximately 35 kilometres west of the community of Invermere, B.C. on N.T.S. mapsheet 82 K/8W (see Figure 1). The claims consist of 30 units in 5 separate claim groups between Coppercrown Mountain, south of Toby Creek, to the headwaters of Law Creek, a northeast flowing tributary of Horsethief Creek (Figure 2).

The claims can generally be accessed with varying degrees of difficulty by logging roads along Law Creek, Bruce Creek, Delphine Creek and/or Toby. The Law Creek road is rough but passable for approximately 5 kilometres from the confluence of Bruce and Law Creeks to a washout and then by foot or motorcycle for an additional 2 kilometres to the headwaters of Law Creek. The condition of the road beyond the washout is adequate for vehicles to pass but the presence of large boulders on the road makes it impassable. The road could be upgraded and made traversable by blasting / bulldozing the boulders off the road and repairing the washout should the need arise.

There has been relatively recent logging activity in the lower reaches of Bruce Creek and the road is believed to be in good condition, possibly allowing vehicle access for approximately 5 kilometres. The current condition of the road is unknown as a helicopter was utilized this year for the purposes of prospecting. It may be navigable by motorcycle but if not should be considered for repair as it is not feasible to walk in for a days work. It may be more feasible to establish short duration fly-camps to facilitate mapping and sampling of this claim group.

The Toby Creek road is maintained as a good gravel road and provides access to the Delphine Creek road, which is passable for approximately 1 kilometre to a washout, and the confluence of Toby Creek and Stark Creek, by which access to the Alpine claims is possible, but difficult. Helicopter access to the Alpine claims provides a more cost effective method of access for the purposes of future work.

PHYSIOGRAPHY AND CLIMATE

The claims are located between Coppercrown Mountain, south of Toby Creek, and the headwaters of Law Creek. Relief varies from 1280 metres (4200 feet) along Toby Creek to more than 3110 metres (10,200 feet) on Mt. Catherine (Fig. 2).

The claims range from exposures in an alpine environment with abundant glacial morainal deposits and colluvial detritus through sub-alpine to well below tree line in coniferous forest. Vegetation at lower levels in the area consists of a mixture of coniferous and deciduous trees with the undergrowth comprised largely of slide alder, shrubs and / or Devil's Club.

The claims are located east of Kootenay and Trout Lakes in a regional topographic high and are therefore subject to heavier precipitation than further to the north and south. As a result, the region has many icefields and small glaciers developed in the area. The properties are available for geological exploration from May or June to late October.
CLAIM STATUS

The properties consist of 3 2-post and 2 4-post (MGS) claim (see Figure 3a), staked in accordance with existing government claim location regulations. The claims were staked on behalf of Elizabeth Walker, who retains a 20% carried interest in the claims. The remainder (80%) was held in trust for Gwen Resources Ltd. By undertaking sufficient assessment work to hold the claims in good standing for a minimum of one (1) year, Nihilist Corporation earned a 30% interest from Gwen Resources Ltd. As such, the claim ownership is as follows: Gwen Resources Ltd. (50%), Nihilist Corporation (30%) and Elizabeth Walker (20% carried). Significant claim data is summarized below:

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Copies of claim application forms are provided in Appendix B.

*After 1998 assessment credit applied.*
HISTORY

The area between Toby and Horsethief Creeks has over 80 documented mineral occurrences for commodities such as lead, silver and copper. These occurrences vary in size from small showings up to the 1.2 million tonne Mineral King deposit (Past Producer) just north of Toby Creek and west of Jumbo Creek. Other mineral deposits include (from south to north): Silver Spray, Kootenay Queen, Hot Punch, Delphine, Nip and Tuck, Silver Queen, Ptarmigan and the Iron King. The majority of the mineral occurrences are fault and/or vein type deposits.

These mineral occurrences are coincident with a north-south belt of lamprophyric to kimberlilite dykes interpreted to be closely associated with the locus of the "Windermere High". Mineral deposits proximal to known dyke occurrences are briefly described below.

Mineral King Mine

The Mineral King mine is located north of Toby Creek and west of Jumbo Creek at an elevation between 1220 metres (4005 feet) and 1670 metres (5480 feet). The mine produced a total of 1,334,400 tons of ore at a reported grade of 8 percent zinc and 3 percent lead per ton before suspending operations in 1964 (Pope 1990).

The deposit is interpreted as a Stratabound Massive Replacement in a high angle fault panel within the Mineral King duplex system in the footwall of the Mount Forster fault. The orebody is hosted in brecciated dolomite of the Lower Gateway Formation and consists of galena, sphalerite, tetrahedrite (containing 6 to 7 percent silver), pyrite and barite with minor chalcopyrite and pyrrhotite (Pope 1990).

Kootenay Queen Group

The Kootenay Queen Mine is located in a cirque south of Delphine Creek at an elevation of 1980 metres (6495 feet). The orebody is hosted within the Mount Nelson Formation (white marker member), immediately below the interpreted position of the Windermere Unconformity. The orebody consists of galena, tetrahedrite and sphalerite with reported recovery of less than 100 tons having a grade of 2400 grams per tonne silver and 70 percent lead.

Silver Queen Mine

The Silver Queen mine is present at the base of a cliff on the west side of Mt. Slade at an elevation of 2900 metres. The mine consists of a system of small veins situated in the lower main dolomite of the Hadrynian Mount Nelson Formation and is associated with a green metadiabase dyke. The main workings were within a 20 centimetre wide vein hosting galena and sphalerite with minor chalcopyrite having a reported production of less than 100 tons with a grade of 2.35 kilograms per tonne silver and 59 per cent lead.
Silver Spray Mine

The Silver Spray Mine is situated on the west side of Coppercrown Creek at an elevation of 2290 metres and is part of a group of claims which includes the Lady Bing, Gracie Fraction, Betsy and IOU properties. The workings are contained in the dolomite dominated upper portion of the Lower Gateway Formation immediately below the unconformably overlying Dutch Creek Formation. Up to 50 tons of ore were recovered consisting of galena, tetrahedrite and cerussite with minor sphalerite and copper carbonates in vertical and bedding parallel fractures.

Pretty Girl Group

The Pretty Girl Group is situated on the ridge crest between Law and Bruce Creeks at an elevation of 2720 metres. Stratigraphically the Pretty Girl Group is located within argillites of the Horsethief Creek Formation. The mineralization is reported to consist of tetrahedrite and chalcopyrite in a discontinuous quartz vein with less than 50 tons recovered at grades up to 188 grams per tonne silver and 27 per cent copper.
REGIONAL GEOLOGY

Stratigraphy

The stratigraphy of the Purcell Mountains (see Figure 4) consists of four separate and distinct, megascopic miogeoclinal sequences interpreted to have been deposited on passive North American continental crust. This Helikian to Lower and Upper Palaeozoic package has undergone four major phases of deformation and variable thermal metamorphism related to the Horsethief Creek Batholith. Igneous activity has periodically influenced the sedimentary sequence and includes syn-depositional basaltic to andesitic flows and/or sills to post depositional intrusive dykes, sills and batholiths.

The sedimentary sequence exposed between Toby and Horsethief Creeks (the Toby Creek area) comprises the uppermost Helikian Belt-Purcell Supergroup, the Hadrynian Windermere Supergroup, and Lower Paleozoic strata to the Middle Devonian Starbird Formation. These strata are exposed in six separate panels bounded by thrust faults, and carried in the hanging wall of the northeast vergent Purcell Thrust.

Proterozoic

Belt-Purcell Supergroup

The Helikian Belt-Purcell Supergroup has an exposed thickness of 4300 metres, from within the Van Creek Formation to the Mount Nelson Formation. The Belt-Purcell Supergroup is comprised predominantly of cliff-forming, buff weathering dolomitic lithologies with intercalated siliciclastic intervals.

The Van Creek Formation is the lowest formation exposed in the Toby Creek area. It consists of approximately 500 metres of medium- to coarse-grained, light grey to dark green quartzites, siltstones and silty argillites exposed in the core of an anticline. The Nicol Creek Formation is absent as the Van Creek quartzites apparently grade upward into over 1000 metres of pale green quartzites, silts and buff weathering dolomitic silts of the Lower Gateway Formation.

The Lower Gateway Formation has been subdivided into two members, a basal transitional sequence and an upper dolomite dominated sequence. The transitional sequence is up to 100 metres thick. The base is identified as the first occurrence of carbonate above which are distinctive thin bedded, red spotted quartzites with interbedded green siltstone and buff weathering dolomitic siltstone and dolomite.

The Upper Gateway Formation is dominated by thin bedded dolomite which passes upward into a 90 metre thick, cream to buff weathering dolomitic unit. The dolomite has cryptalgal and stromatolitic
laminations and cream coloured chert intercalations. The dolomite ranges from blue-grey micrite to light coloured coarse sucrose textured dolomite.

A sharp contact has been mapped separating the Upper Gateway Formation from the overlying Dutch Creek Formation. The contact is a narrow, rusty-weathering zone interpreted to represent a hiatus along a parallel unconformity. The Dutch Creek Formation varies from 300 to 1000 metres over less than 5 lateral kilometres and consists of dark coloured, fine-grained quartzite-argillite couplets.

The contact with the overlying Mount Nelson Formation is always very sharp with an abrupt change in facies and sedimentary characteristics evident across the contact, which is interpreted as a paraconformity. The Mount Nelson Formation is approximately 1300 metres thick, consisting of thick, well-bedded white orthoquartzite, buff weathering dolomites and purple weathering dolomites and argillites.

The Mount Nelson Formation has been subdivided into the:

a) lower quartzite, a useful 50 to 150 metre thick marker horizon consisting of white, well-sorted, fine to medium grained pure quartz arenites,

b) lower main dolomite - an approximately 400 metre thick sequence which conformably overlies and is gradational with the lower quartzite, comprised of cryptalgal to stromatolitic laminated, pale grey weathering dolomites with interbedded carbonaceous argillites capped by a cream-coloured stromatolitic, crystalline cherty-dolomite unit approximately 20 metres thick overlain in sharp contact by,

c) the middle quartzite - an apple green coloured sequence consisting of massive, fine- to coarse-grained quartz arenites, impure sandstones and argillites having A-B to A-E Bouma sequences evident,

d) orange dolomite sequence - approximately 180 metres thick consisting of varicoloured buff weathering dolomitic siltstones, argillites and impure sandstones underlying bright orange-buff weathering silty and sandy crystalline dolomites with abundant cryptalgal and stromatolitic laminations and intercalated chert.

e) white markers conformably overlie the orange dolomite and are up to 70 metres thick. The white markers consist of cream, buff and silver-grey dolomites with purple, green and buff dolomitic mudstones and local interbeds of pure white magnesite up to 1 metre thick,

f) purple sequence - gradationally overlies the white markers, consisting of purple weathering dolomitic sandstones and siltstones which grade upward into purple weathering argillite. Mudchip breccias and monomict pebble conglomerates are interbedded with siltstones and argillites and the sequence is overlain by a pebble to boulder conglomerate with a purple weathering sandy argillitic matrix in sharp contact with the purple shales. The pebble to boulder conglomerate is the interpreted locus of an intraformational unconformity with a thickness between 2 and 10 metres thick,

g) upper middle dolomite - approximately 80 metres thick and similar to the lower main
dolomite. It is distinguished by abundant algal allochems which are typically replaced by black chert.

h) upper quartzite - a distinctive cliff-forming unit consisting of white quartzites more than 260 metres thick (equivalent to the upper Mount Nelson Quartzite (Atkinson 1975)). The upper quartzite consists of well sorted medium- to coarse-grained, essentially pure arenites. They are distinguished from the lower quartzite on the basis of massive bedding and poorly preserved sedimentary structures.

i) upper dolomite - the uppermost unit in the Belt-Purcell exposed below the Windermere unconformity. The upper dolomite is gradational with the underlying quartzite over 10 metres consisting of interbedded purple argillite, quartzite and dolomite. The upper dolomite is comprised of pale to dark grey dolomite interbedded with quartz and dolomite pebble conglomerates with dolomitic quartz sands.

Windermere Supergroup

The Windermere Supergroup varies in thickness in the Toby Creek area, from 80 metres to over 3 kilometres and is in sharp contact with the underlying Belt-Purcell Supergroup across an unconformity with considerable topography, interpreted as a result of a local basement high, the "Windermere High" (Reesor 1973). The Windermere Supergroup was deposited above this unconformity and consists of a basal conglomeratic unit, the Toby Formation, and the overlying argillite and pebble conglomerate dominated Horsethief Creek Formation.

The Toby Formation is the basal unit of the Windermere Supergroup and overlies different levels of the Belt-Purcell stratigraphy in the separate fault panels, interpreted to indicate active faulting during sedimentation (Pope 1990). Four distinct facies have been identified in the Toby Creek area but their stratigraphic position relative to one another is uncertain due to rapid lateral facies changes.

The Toby Formation consists of:

a) a boulder breccia lithofacies consisting of monomict clast-supported boulder breccias developed at the base of the Toby Formation.

b) a diamictite lithofacies - the most commonly developed facies consisting of rounded quartzite and subangular dolomite boulders (derived from the immediately underlying Mount Nelson Formation) in a sandy argillite matrix.

c) a sparse clast diamictite lithofacies consisting of graded fine- to coarse-grained, poorly sorted arenites and argillites with a minor component of rounded quartzite pebbles or cobbles.

d) a siltstone-argillite lithofacies which comprises the bulk of, and is the dominant lithology in, the upper portion of the Toby Formation, consisting of well-sorted and graded fine quartz arenites and argillites which typically exhibit complete Bouma sequences.

The Toby volcanics are the oldest igneous rocks identified in the Toby Creek area and are
believed to be altered submarine basalts related to regional Hadrynian extension. The flows are holocrystalline and glomeroporphyritic basaltic andesites, having plagioclase phenocrysts in a fine-grained plagioclase groundmass.

Green metadiabase dykes have also been identified and have been considered equivalent to the Toby volcanics. They are the most common igneous rocks and are always intruded at a high angle to bedding. They are typically altered, consisting of anhedral masses of chlorite, anhedral to euhedral carbonate and sericite and skeletal opaques. Chlorite pseudomorphs after pyroxene and amphibole have been identified. Bulk mineralogical proportions indicate these dykes were most probably originally basaltic in composition and have been subsequently hydrated.

The Toby Formation is gradational into the overlying Horsethief Creek Formation, in which five lithofacies have been identified. These lithofacies define a rudimentary stratigraphy of facies within the Horsethief Creek Formation as individual lithological units are inconsistent due to rapid lateral thickness and facies variations.

The lithofacies identified in the Horsethief Creek Formation are as follows:

- siltstone-argillite - dominant in the lower half of the Horsethief Creek Formation and separate the remaining lithofacies throughout the formation. This lithofacies consists of thick sequences of thin bedded, graded siltstone and argillite and finely laminated black, green and grey argillite.
- black carbonate - an easily traced marker used to identify and map the base of the Horsethief Creek Formation consisting of thin bedded, dark grey to black limestone with variable quartz sand and silt in a calcitic matrix and thin calcareous quartz-arenite beds.
- dolomite - buff weathering dolomite, up to 30 metres thick, dolomite pebble-conglomerate beds and dolomite supported quartzite occur throughout the Horsethief Creek Formation.
- quartz feldspar arenites and pebble conglomerates consist of pebble conglomerates comprised of grain-supported crystalline quartz and quartz feldspar grains with variable red jasper, green to grey argillite, quartzite and dolomite clasts in a quartz, feldspar, carbonate, sericite and chlorite matrix. Clasts are generally 1 to 2 centimetres in diameter but may exceed 10 centimetres in length. Quartz feldspar arenite beds are similar to the pebble conglomerates but have a greater proportion of matrix and are generally poorly sorted.
- red and varicoloured argillites are present at the top of the Horsethief Creek Formation and consist of variably coloured argillites with interbedded pink carbonate, and varicoloured impure arenites.

Lower Paleozoic

The Paleozoic succession is comprised of the Lower Cambrian Cranbrook Formation, Middle Cambrian Jubilee Formation, Ordovician-Silurian Beaverfoot Formation, Middle Devonian Mount Forster Formation and the Upper Devonian Starbird Formation. The Paleozoic
stratigraphy neither hosts nor have Paleozoic clasts been identified in the kimberlitic dykes and therefore will not be described at this point. The reader is referred to Pope (1989), Root (1985, 1983) and Reesor (1973), for a complete description of Paleozoic stratigraphy in the Invermere area of the Purcell Mountains.

Middle Cretaceous

The Horsethief Creek Batholith (see Figure 3) is a quartz monzonite intrusion present north of Horsethief Creek and therefore out of the Toby Creek area. However, granitic apophyses and aplitic dykes are present throughout the Toby Creek area and thermal metamorphism related to the batholith has affected the strata of the area.

Permo-Triassic

Ultrabasic to ultra-potassic dykes have been recently described (Pope and Thirlwall 1992) extending from Stark Creek northward to Law Creek (see Figure 4). These intrusive dykes define a broad north-south belt spatially associated with the intersection of the Nelson Creek Fault and the Bruce Creek Synform, possible basement control related to the locus of the Windermere High.

The dykes occur as rusty weathering, variably carbonatized intrusive bodies ranging from 50 centimetres to 10 metres thick. They have narrow chilled margins and show little or no evidence of contact metamorphism with either the host lithologies or xenoliths. This has been interpreted as evidence for rapid intrusion and quick cooling of the dyke material.

The dykes are xenolithic, ranging from approximately 5 percent to more than 50 percent by volume, and include: pyroxenite nodules, abundant Belt-Purcell quartzite and argillite lithologies and quartz-feldspar xenocrysts derived from either Hudsonian basement or Mesozoic-Cretaceous granitoids intrusives.

The occurrences have been subdivided into two suites based on petrology and chemistry (Table 1). Group A are considered to be lamprophyres having kimberlitic affinity whereas Group B dykes are considered to be true kimberlites (Pope and Thirlwall 1992).

Group A dykes are typically light green in colour with phlogopite phenocrysts absent to abundant (porphyritic) in a carbonate rich matrix and carbonate-iron oxide pseudomorphs after euhedral olivine. Olivine pseudomorphs are recognized by their crystal outline and relict serpentine fractures. The matrix consists of fine-grained carbonate, opaques and iron-stained, fine-grained laths, possibly an alteration product of a micaceous or feldspathic phase.

Xenoliths are abundant in Group A dykes, typically more than 50 percent xenoliths by volume, and are almost exclusively derived from the underlying Belt-Purcell Supergroup. However, granitic gneiss and ultrabasic xenoliths are also reported to occur. Group A dykes correspond to
Table 1: Whole rock chemistry for ultrapotassic - ultra-potassic dykes in the Toby - Horsethief Creek area (modified from Pope and Thirlwall 1992). The "A" series analyses are from Group A (kimberlitic lamprophyre) dykes, "B" series analyses are from Group B (true kimberlite) dykes while the last three are independent analyses of material from the Toby - Horsethief Creek area.

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the lamprophyre-kimberlite field (Pope and Thirlwall 1992), transitional between rift and active orogen type volcanics.

Group B dykes are typically dark green in colour. They are porphyritic with phlogopite phenocrysts up to 8 centimetres long and apatite phenocrysts up to 0.5 millimetres in diameter poikilitically enclosed by phlogopite. Phlogopite crystals are also intergrown with calcite, suggesting that calcite may also be primary.

Matrix phases identified include: carbonate, serpentine, chlorite, phlogopite, apatite and opaques. The presence of abundant matrix calcite distinguishes group B dykes from lamproites (Pope and Thirlwall 1989, after Dawson 1987). The xenolith content of Group B dykes is
typically less than 10 percent by volume.

Group B dykes are petrologically similar to kimberlites (Pope and Thirlwall 1992) and are classified as continental rift associated ultrapotassic rocks with kimberlitic affinities. They can be further defined as micaceous kimberlites, due to the high proportion of phlogopite, matrix calcite and apatite (Pope and Thirlwall 1992).

Structure

Four major phases of deformation have been identified in the Toby Creek area, Helikian-Devonian extension (D1), Jurassic-Paleocene contraction (D2-D3) and Eocene extension (D4).

The first phase of deformation resulted in the unconformities at the base of the Dutch Creek and Mount Nelson Formations (D1a) and the unconformity at the base of the Windermere Supergroup (D1b). Thinning of Paleozoic strata onto the Windermere High is interpreted to reflect the effects of D1c deformation together with the development of small fault-bounded sub-basins.

Contraction during the Columbian (D2) and Laramide (D3) orogenies resulted in a series of northeast vergent thrust faults and the development of a regional foliation (S1). Three major thrust sheets are evident in the Toby Creek area with one, the Mount Nelson thrust sheet, comprised of four smaller fault panels. The three major thrust sheets represent out-of-sequence faults, having propagated toward the hinterland, carried in the hanging wall of the Purcell Thrust.

Contraction during D2 and D3 produced east-vergent imbricate thrust faults and west vergent backthrusts. Many of these faults were subsequently reactivated during the fourth phase (D4) of deformation. High angle brittle faults are also a result of D4.
LOCAL GEOLOGY

ALPINE Group

The ALPINE Claim group (Fig. 5) was staked to cover the ultra-potassic dyke of kimberlitic affinity identified as “A4” in Table 1 (Pope and Thirlwall 1992). The ALPINE claim group contains three dykes of possible kimberlitic affinity in the headwaters of Stark Creek, with at least six additional dykes present on or immediately adjacent to the claim group. The dykes all trend north-south and are hosted within dolomites and quartzites of the Helikian Van Creek Formation.

Two dykes are present in a small spur projecting to the south from the cliffs east of Stark Creek. They are each less than 3 metres thick and extend approximately 200 metres from glacial detritus to the cliff wall. They are buff to dark green weathering and resistant. Narrow chilled margins (up to 3 centimetres thick) are present on either contact with host strata. A moderate foliation is developed which results in thick plates of weathered ultrabasic material in the talus below the exposure.

On fresh surfaces, the dykes are moderate green weathering with relatively abundant calcite developed in the matrix, possibly a secondary replacement mineral (after olivine?). Individual phenocrysts are less than 0.5 centimetres in diameter with the exception of phlogopite, which is up to 2 centimetres in long dimension.

Two of the larger dykes have been described previously and are visually and distinct compositions. The East Dyke is 2-8 m wide and is oriented 170/60°E. It has a dark blue-green to black colouration, and contains two distinct textural variations (massive and porphyritic), suggesting two phases of emplacement. The West Dyke is located 150 m west of the East Dyke, and is 1-2 m in width, oriented 170/55°E. It has a distinct dirty-red colouration, and is brecciated throughout, with angular clasts of heterogeneous sedimentary and volcanic (possibly hypabyssal) material distributed in a weakly hematitic, fine-grained groundmass. This dyke continues off the claims to the northeast.

The third dyke is exposed at the north-east end of the claims and projects to the south and north. The dykes is estimated to be up to 10 metres thick, consisting of dark weathering, resistant material.

BRUCE Group (Fig. 6)

The dyke occurrence which reportedly occurs in the headwaters of Bruce Creek has not been confirmed due to the amount of snow present. Two cross-cutting dykes were observed on the north side of the valley, extending from snowline upward to the northeast through a cliff-forming unit of the Mount Nelson Formation. The two dykes are each less than 5 metres thick, dark green to black weathering and are thought to represent the lamprophyres of kimberlitic
affinity described. They appear to be very similar to the Alpine West dyke located on the ALPINE claims.

**C12 Group**

The C12 claim group contains one known dyke occurrence, located at the head of Law Creek (Fig. 6). The occurrence was described by Pope and Thirlwall (1992) as being kimberlitic lamprophyre (Group A) dyke. This occurrence appears to be either a "blow" (local widening of a dyke or sill) or a pipe. The outcrop has an elongate to ellipsoidal exposure but no definite conclusions can be reached without further mapping. The "dyke" is oriented approximately north-south, extending southward where it is covered by a small glacier/icefield and northward under talus. The exposed outcrop is approximately 50 metres wide at its widest point and thins to less than 10 metres below the glacier. Two distinct phases are present consisting of a xenolith-rich phase and an essentially xenolith-free phase. Both phases are buff weathering with the xenolith-poor phase cross-cutting the xenolith-rich phase. Xenoliths are up to 30 centimetres in long dimension and consist almost exclusively of elongated or flattened sedimentary clasts (siltite, carbonate and quartzite). Possible igneous inclusions were also identified (trachyte?). Rich lime green inclusions are locally present which are tentatively identified as chrome-bearing micas (fuchsite or mariposite).

**SUL Group**

The SUL claim group contains two possible ultramafic occurrences (Fig. 7), one at approximately 1737 metres (5700 feet) in the Sultana Creek drainage and a possible occurrence along a trail at approximately 1722 metres (5650 feet), south of Sultana Creek. The occurrence within Sultana Creek is in situ outcrop while the occurrence along the trail may be proximal float.

The occurrence along Sultana Creek is present on the southern bank and is exposed through glacio-fluvial cover. The outcrop extends approximately 10 metres above the level of the creek and approximately 5 metres along the creek. It is a medium green weathering rock with light to medium orange weathering interstitial carbonate. Phlogopite phenocrysts are present up to 0.75 cm in long dimension and imparts a porphyritic texture to the exposure. The phlogopite has a greenish colour and is interpreted to be partially altered to chlorite. The abundance and nature of the carbonate suggests that much of it is primary but additional secondary carbonate has been developed through alteration of primary olivine. Primary olivine is recognizable, in thin section, by relict crystal shape (outlined by opaques) and characteristic serpentine fractures.

The occurrence is located at or near the locus of three thrust faults and has intruded host lithologies of the Hadrynian Dutch Creek Formation (Pope 1990). Geological mapping of the occurrence has not been sufficient to determine the timing of intrusion relative to the thrust faults, however, it is interpreted to pre-date thrusting as it has been foliated. In addition, the nearby Toby Creek occurrence has been dated at 245 ± 2.4 Ma and therefore, as the intrusives
are almost certainly coeval, was intruded during the earliest stages of the Columbian Orogeny.
1997-98 PROGRAM

On June 2, 1998, the author and a field assistant visited the SUL and ANNE claims in an attempt to locate diatreme occurrences previously described and prospect for any additional occurrences and/or mineralization.

On June 6, the author and two assistants flew from Cranbrook to the Alpine, Bruce and C12 claim groups using a helicopter chartered from Bighorn Helicopters Inc. The author believed that a helicopter would provide a cost effective means of accessing and prospecting these claims due to the uncertainty of road access. However, the presence of persistent, late season snow on the claims hindered effective prospecting.
RESULTS

ALPINE Group

On June 6, the author and two field assistants undertook prospecting of the Alpine claims (Fig. 5). The West Dyke and associated float was inspected. Limited prospecting was undertaken to the north and west of these occurrences in an attempt to locate a pipe described by A. Pope (pers. comm, 1990). However, due to the presence of significant amounts of late season snow in the north facing cirque, effective prospecting was hindered and no additional in situ occurrences were identified.

The helicopter landed and shut down at an elevation of 2299 m (7542') at approximate GPS coordinates G.P.S. 543460 E, 557616 N. A boulder of diatreme float was located at approximate GPS coordinates 543343 E, 5571816 N. The boulder may have been derived from the dykes identified and described previously, however there is a gully between the dykes and the float boulder, possibly suggesting an alternate source.

ANNE Group

Limited prospecting was undertaken on the ANNE claims in an attempt to locate a small exposure of possible kimberlitic affinity previously noted. The exposure was described as similar in appearance to the exposures on the GEM property immediately to the north.

The claims were accessed by utilizing an old trail south of Toby Creek (Fig. 5). The trail starts approximately 20 m south of the bridge over Toby Creek immediately west of Mineral Creek and is driveable for approximately 100 m. However, utilizing All Terrain Vehicles allows trail access to the claims approximately 4 kilometres farther west.

The author and an assistant attempted to locate the small exposure described (or any other occurrences) but were unable to do so as a result of the thick undergrowth and vegetation on the north-facing slopes south of Toby Creek. The author is of the opinion that this and/or other exposures on the ANNE claims are critically important in the event that kimberlite indicator minerals and/or diamonds are identified on the GEM claims and/or the ALPINE claims. Therefore, additional prospecting is strongly recommended. Alternatively, if dykes, sills and/or pipes of kimberlitic affinity are present on the claims, geochemical and/or geophysical survey(s) should result in identification of these occurrences relative to sedimentary host lithologies.

BRUCE Group

Due to uncertainty regarding vehicle access along Bruce Creek, a helicopter was utilized to access the BRUCE claims for the purposes of prospecting (Fig. 6). The helicopter landed at an elevation of 2394 m (7854'), north of Bruce Creek near a small lake at the headwaters (approximate GPS coordinates 543501 E, 5590183 N). Although there was less snow on the
southwest facing slopes than encountered on the ALPINE claims, effective prospecting was still hindered.

The author and two assistants prospected up the slope to the northeast of the helicopter to the base of a hanging valley / cirque. Float of possible kimberlitic affinity was encountered on the east side of the bowl on a southwest facing slope. There was also float of a green-grey finer grained phase which may represent a different source. The probable source of this material lies at a higher elevation to the east.

Three dykes of unknown composition were noted across the valley on the east-southeast side of Bruce Creek and at least four on the west-northwest side. Two dykes are present above the upper lake in the headwaters of Bruce Creek, two between the upper and lower lakes which appear to extend across the valley and at least one in the west face of Mt. Nelson. Additional dykes are present east-southeast of Bruce Creek below Sultana Peak.

At least two dykes extend north from Bruce Creek into the cirque and possibly into the headwaters of Law Creek (and the C12 claims?). The dykes are dark green to black on weathered surface and have a well developed foliation. The dykes are each approximately 2 m thick and 45 m apart. The foliation (S₁) trends 330°/75° and appears to be axial planar to a broad syncline mapped to the west. A second crenulation (S₂) cross-cuts S₁ and trends 237/79°.

SAMPLE BRUCE 98-1 - Dark black weathering rock found in float with possible sphalerite.

SAMPLE BRUCE 98-2 - Strongly iron-stained dolomitic float boulder with moderately abundant disseminated iron pyrite ± ?

C12 Group

On June 6, the author and two assistants utilized a helicopter to access the C12 claim due to the uncertainty of access along / to the Law Creek Road. The helicopter landed on exposures of the diatreme at an approximate elevation of 2620 m (8600') at the headwaters of Law Creek (Fig. 6).

The diatreme is cross-cut by the stream draining the icefield, at higher elevation to the south. The diatreme consists of dark grey weathering phyllitic siltstone (similar to host lithologies), highly subordinate wacke inclusions in an orange weathering hematite-rich matrix. The diatreme consists of up to 80% inclusions, all of which have a preferred, sub-parallel orientation. The proportion of inclusions to matrix varies from 25% (matrix supported) to 80% (inclusion supported).

The diatreme is cross-cut by relatively abundant quartz + hematite veins. Two generations of quartz veins are evident, an early set of milky quartz with ankerite (trending 136°/58°) and a second, later set consisting of milky quartz trending 282°/87°.
Approximately 75 m above the lower contact of the diatreme lies the trace of a possible fault, having a west side down and/or right lateral sense of motion. The inclusion-rich phase terminates abruptly against sediments across a small 0.5-1.0 m wide gully which trends approximately 238°/80°E. An exposure of medium to dark green weathering carbonate-rich gabbro (?) with abundant hematite outcrops approximately 50 m farther up. Alternatively, this exposure may represent a carbonate-rich kimberlite feeder to the diatreme.

A cliff band is present below the diatreme comprised of 4 m of fissile, medium to dark green phyllitic siltstone with interbedded quartz-rich wackes overlain by light grey to buff-yellow limestone and silty limestone, with interbedded silty layers up to 0.5 m thick.

A thin (30cm), possibly kimberlitic, dyke cross-cuts the sediments, having an orientation of 326°/73°. The dyke is orange-brown weathering with a well developed foliation parallel to that developed in the host sediments. It contains inclusions (predominantly limestone with minor chert) up to 3 cm in long dimension which are oriented parallel to the foliation. Small black metallic euhedral to subhedral crystals were noted, surrounded by bright green stains. The dyke can be traced for approximately 15m.

The dimensions of the "dyke" together with the ubiquitous preferred orientation of flattened inclusions/xenoliths indicates that the "dyke" may more accurately be described as either an attenuated blow in a dyke/sill or an exposed pipe. Additional examination and mapping is highly recommended to determine if the Law Creek occurrence is a deformed pipe.

**SUL Group**

On June 2, the author and an assistant accessed the Sul claims by vehicle from Delphine Creek. The road is washed out approximately 1.2 kilometres up Delphine Creek (Fig. 7). The remainder of the road was walked for an additional 1.6 kilometer to the claims. Approximately 1.6 kilometres east of Sultana Creek, an old road can be utilized to access the core of the Sul claims.

In previous reports, copper-bearing (malachite + azurite + chalcopyrite) float was sampled from the trail. The area up slope from the float was prospected and a probable source of the float identified. An old blast trench was identified at an elevation of approximately 1683 m, located above the end of the old road (where it undergoes transition to a trail). The trench exposes iron-stained green and greenish-yellow, thin bedded dolomitic siltstones at approximate GPS coordinates 545448 E, 5585906 N. An approximate bedding (S_o) orientation of 162°/75° was measured.

The sediments host steeply south dipping fractures (possibly a coarse foliation) infilled with secondary cross-cutting quartz veins. Poddy chalcopyrite and galena with azurite and subordinate malachite is contained in these veins and veinlets. A chip sample was taken from these veins over an area of 0.5 m. The blast trench is a triangular shaped exposure having the
dimensions 6 m along contour, 6 m high and 2 m deep.

The diatreme was located in Sultana Creek at an elevation of 1756 m (5760'). The exposure is finer grained relative to the occurrence on the GEM property to the south, consisting of a dark green matrix with phlogopite and apatite phenocrysts. One piece of float contained a 2 cm rounded, black, probable pyroxenite nodule and books of black phlogopite-biotite up to 1.5 cm in diameter.

The diatreme exposure is hosted by orange-buff weathering dolomite which structurally overlies the outcrop. The beds are (locally) moderately steeply southeast dipping (141°/47°). The diatreme is probably a dyke striking 230°, dipping 80° W. Dark anastomosing bands in the host rock proximal to the exposure are interpreted to be the result of hydrothermal alteration.

A small right lateral offset is evident across the gully cross-cutting the dyke, having a displacement of 6-10 metres.
CONCLUSIONS AND RECOMMENDATIONS

Dykes of kimberlitic affinity are known to occur in a north-south belt (Pope and Thirlwall 1992), within which the Toby Creek area claims are located (see Figure 3a). "(The) common petrogenesis and extensional, fault-controlled structural setting, coupled with essentially identical ages of emplacement, lead us to postulate that the Toby - Horsethief Creek dykes and the Cross kimberlite evolved in parallel, during a single phase of continental extension." (Pope and Thirlwall 1992)

Previous geochemical analysis of the occurrences does confirm a composition of kimberlitic affinity, though thin section examination suggests a possible carbonatitic origin. None the less, the Law Creek occurrence (C12 claims) is likely a diatreme breccia which appears to have sampled deep-seated material, and the potential for them to be diamondiferous is significant, particularly in view of diamond field inclusion chrome diopside, G3 eclogitic garnet and chromites of possible lamproitic affinity. If the occurrences are in fact found to be carbonatites, then the potential for hosting Rare-Earth Elements (REEs), Platinum Group Elements and gold is significant.

Additional work is recommended on the separate claim groups. Known occurrences should be mapped in detail (1:10 000 scale), additional samples should be taken for geochemistry and thin section analysis. Several larger bulk samples (minimum 100 kg) should be taken from the occurrences and the cross-cutting dykes and processed for recovery of heavy minerals (including diamonds). The magnetite / sulphide fraction should be analyzed for Platinum Group Elements and a representative whole rock fraction should be analyzed for base / precious metals and Rare Earth Elements. A follow-up program of trenching and drilling is recommended upon confirmation of kimberlitic affinity for the dykes / "blow" in terms of composition, elemental suites, kimberlitic indicator minerals and / or deep seated xenoliths (peridotitic and / or eclogitic inclusions). Trenching, possibly with blasting, would enable the collection of a large sample of pristine dyke material for a determination of diamond content. Drilling is recommended upon favourable results in geochemistry, in terms of a kimberlitic indicator (heavy mineral) and / or xenolith suite. A tentative budget proposal has been prepared for the above work and is presented on the following page.

The fact that kimberlites and lamprophyres of kimberlitic affinity have been documented in a new, previously unknown, terrane clearly indicates that more exploration is warranted in the Purcell Mountains. The close association postulated by Pope and Thirlwall (1992) between diatremes mapped in the Rocky Mountains in terms of alkaline composition, age of intrusion and volcanic association demands that these occurrences be thoroughly evaluated for their potential as hosts for diamonds. The recovery of several diamonds in the Golden cluster of diatremes and the kimberlitic affinity of the Purcell Mountain occurrences suggests these occurrences may be possible diamond hosts.
# Proposed Budget

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Contingency on Field Program (10%)  
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REFERENCES


Appendix A

Statement of Qualifications
STATEMENT OF QUALIFICATIONS

I, Richard T. Walker, of 656 Brookview Crescent, Cranbrook, BC, hereby certify that:

1) I am a graduate of the University of Calgary of Calgary, Alberta, having obtained a Bachelors of Science in 1986.

2) I obtained a Masters of Geology at the University of Calgary of Calgary, Alberta in 1989.

3) I am a member in good standing with the Association of Professional Engineers, Geologists and Geophysicists of Alberta.

4) I am a member of good standing with the Association of Professional Engineers and Geoscientists of the Province of British Columbia.

5) I am a consulting geologist and Principal with the firm of Dynamic Exploration Ltd. with offices at 656 Brookview Crescent, Cranbrook, British Columbia.

6) I am the author of this report which is based on work I personally performed on June 2 and June 6, 1998.

7) I hold interests in both Gwen Resources Ltd. and Nihilist Corporation, both registered in the Province of Alberta.

Dated at Cranbrook, British Columbia this 17th day of September, 1998.

Appendix C

Statement of Expenditures
STATEMENT OF EXPENDITURES

The following expenses were incurred on the Toby Creek area claims for the purpose of prospecting within the period June 1 and June 7, 1998.

PERSONNEL

R.T. Walker, P.Geo.: 2.0 days @ $450.00/day .................................................. $ 900.00
K. Wasylowich: 2.0 days @ $200 / day ............................................................... $ 400.00
B. Schmidt: 1.0 days @ $100 / day ................................................................. $ 100.00

EQUIPMENT RENTAL

4WD vehicle - 1 day @ $75 / day ................................................................. $ 75.00
- mileage - 340 km @ $0.30 / km ................................................................. $ 102.00
GPS - 2 days @ $15 / day .............................................................................. $ 30.00

FIELD SUPPLIES

5 man-days @ $20 / day .................................................................................. $ 100.00

MISCELLANEOUS

Batteries ........................................................................................................ $ 4.21
Fuel ............................................................................................................... $ 30.00
Helicopter ................................................................................................... $1,340.82

REPORT/REPRODUCTION

R. T. Walker, P.Geo.: 2.5 days x $450.00 / day .............................................. $1,125.00
Drafting - 1 day @ $450 / day ....................................................................... $ 450.00
Reproduction: ................................................................................................ $ 150.00

TOTAL EXPENDITURES: $4,807.03
The following apportioned expenses were incurred on the ALPINE claims for the purpose of prospecting within the period June 1 and June 7, 1998.

PERSONNEL

R.T. Walker, P.Geo.: 0.3 days @ $450.00/day ................................................................. $ 150.00
K. Wasylowich: 0.3 days @ $200 / day ........................................................................ $ 67.00
B. Schmidt: 0.3 days @ $100 / day ............................................................................. $ 34.00

EQUIPMENT RENTAL

GPS - 0.3 days @ $15 / day ............................................................................................ $ 5.00

FIELD SUPPLIES

1 man-day @ $20 / day ........................................................................................................ $ 20.00

MISCELLANEOUS (apportioned)

Batteries ................................................................................................................................ $ 1.41
Helicopter ............................................................................................................................... $ 447.00

REPORT/REPRODUCTION

R. T. Walker, P.Geo. .......................................................................................................... $ 360.00
Drafting ................................................................................................................................ $ 112.50
Reproduction ......................................................................................................................... $ 100.00

TOTAL EXPENDITURES: $ 1,296.91
STATEMENT OF EXPENDITURES

The following apportioned expenses were incurred on the ANNE claims for the purpose of prospecting within the period June 1 and June 7, 1998.

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**TOTAL EXPENDITURES:** $649.25
STATEMENT OF EXPENDITURES

The following apportioned expenses were incurred on the BRUCE claims for the purpose of prospecting within the period June 1 and June 7, 1998.

PERSONNEL

R.T. Walker, P.Geo. 0.3 days @ $450.00/day ................................................................. $ 150.00
K. Wasylowich: 0.3 days @ $200 / day ........................................................................... $ 60.00
B. Schmidt: 0.3 days @ $100 / day ................................................................................. $ 34.00

EQUIPMENT RENTAL

GPS - 0.3 days @$15 /day ................................................................................................... $ 5.00

FIELD SUPPLIES

1 man-day @ $20 / day ........................................................................................................ $ 20.00

MISCELLANEOUS (apportioned)

Batteries ............................................................................................................................... $ 1.41
Helicopter ............................................................................................................................ $ 447.00

REPORT/REPRODUCTION

R. T. Walker, P.Geo.: .......................................................................................................... $ 90.00
Drafting ................................................................................................................................. $ 112.50

TOTAL EXPENDITURES: .......................... $ 926.91
STATEMENT OF EXPENDITURES

The following apportioned expenses were incurred on the C12 claims for the purpose of prospecting within the period June 1 and June 7, 1998.

PERSONNEL

- R.T. Walker, P.Geo.: 0.3 days @ $450.00/day .................................................. $ 150.00
- K. Wasylowich: 0.3 days @ $200 / day ................................................................. $ 67.00
- B. Schmidt: 0.3 days @ $100 / day .......................................................... $ 34.00

EQUIPMENT RENTAL

- GPS - 0.3 days @ $15 / day ........................................................................ $ 5.00

FIELD SUPPLIES

- 1 man-day @ $20 / day ............................................................................... $ 20.00

MISCELLANEOUS (apportioned)

- Batteries ........................................................................................................ $ 1.41
- Helicopter ..................................................................................................... $ 447.00

REPORT/REPRODUCTION

- R. T. Walker, P.Geo.: ...................................................................................... $ 90.00
- Drafting .......................................................................................................... $ 112.50

TOTAL EXPENDITURES: $ 926.91
STATEMENT OF EXPENDITURES

The following apportioned expenses were incurred on the SUL claims for the purpose of prospecting within the period June 1 and June 7, 1998.

PERSONNEL

R.T. Walker, P.Geo.: 0.75 days @ $450.00/day .................................................................. $337.50
K. Wasylowich: 0.75 days @ $200 / day ............................................................................. $150.00

EQUIPMENT RENTAL

4WD vehicle - 0.75 day @ $75 / day ................................................................................... $56.25
- mileage - 255 km @ $0.30 / km ............................................................................ $76.50
GPS - 0.75 days @ $15 / day ........................................................................................... $10.00

FIELD SUPPLIES

1.0 man-days @ $20 / day ...................................................................................................... $20.00

MISCELLANEOUS

Fuel ................................................................................................................................. $22.50

REPORT/REPRODUCTION

R. T. Walker, P.Geo ........................................................................................................ $225.00
Drafting - 1 day @ $450 / day ................................................................................... $112.50

TOTAL EXPENDITURES:  $1,010.25