Skeena Resources Limited
Elkford Project
BC-99-3

Evaluation of the ICE Diamond Exploration Property, Results of the Diamond Drilling and Bulk sampling of the RAM-5, RAM-6 and Bonus Kimberlite targets

NTS 82 G/15W & 82J/2W
Fort Steele Mining Division
50°05' North Latitude
114°58' West Longitude

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May 2, 2002

on behalf of
Skeena Resources Limited
#406, 375 West Hastings Street
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by
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INTRODUCTION

Taiga Consultants Ltd. was originally requested by Mr. J. Rupert Allan, President of Skeena Resources Limited, to supervise a diamond drilling program on the Ice property in southwest British Columbia. The program was designed to test three outcropping kimberlitic intrusions discovered by a previous operator. Due to the lack of available drill water in the region only two targets were drill tested. A third target was blasted and trenched to extract a mini-bulk sample. The program was supervised in the field by Robin E. Chisholm, P.Geol., a principle in Taiga Consultants Ltd.

Drilling and sampling was completed September 2-26, 2001. Reclamation of drill sites and winterizing of access roads were completed September 29-30, 2001. Petrographic examinations of core and hand samples was completed in April 2002 following the completion of a suite of thin sections. Core samples and the mini-bulk sample were treated to recover diamonds in the early months of 2002 as treatment space became available at the laboratories contracted to complete the work.

Location and Access

The Ice property is located immediately northwest of the town of Elkford, B.C. on the west side of the Elk River valley, opposite the Fording Resources Green Hills Coal Mine on the east side of the valley (Figure 1). The targets upon which the recent program were focused are located approximately 7 km northwest of Elkford. Access to the Bonus kimberlite is via the Elk River forestry trunk road (all-weather) for 4 km then exiting to the west along the Crossing Creek road for 7.4 km. At this point, the road splits off to the north and switchbacks directly up the slope for 1.7 km. The Crossing Creek road and the spur which splits off of it are single-lane seasonal tracks suitable for difficult access only by 4x4 vehicles with considerable ground clearance. The tracks revert to snowmobile trails in the wintertime. Access to the RAM-5 and RAM-6 kimberlite targets is gained by driving 5 km to the north along the forestry road and then by turning onto the Tembec forestry road at Kilometre 106 at Round Prairie. A locked forestry gate is situated 1.5 km along the Tembec road. Access to the gate can be made by possession of a key obtained from the Ministry of Forests of BC. The road continues for 2.4 km to the north from the gate following the local topographic contour at which point a single-lane track exits to the northwest, switchbacking up slope for 2.6 km and 3.5 km respectively to the RAM-5 and RAM-6 kimberlite targets. The RAM track roadbed is constituted of firmly packed earth and is suitably trenched and culverted to provide seven months per year of access between April and October.

Claim Status

The Ice property consists of 231 units in 64 claims comprising a nominal area of 5775 ha within the Fort Steele Mining Division. The claims cover an area comprising parts of 1:20,000 map sheets NTS 82J/005, /006, /015, /016 and 82G/096. Parts of the claims area are covered by Mineral Reserve 373336 and 328809 following the course of the Elk River. The *Mineral Tenure Act* of BC (1996) requires that exploration/development work in the amount of $100/unit/year in the first three years,

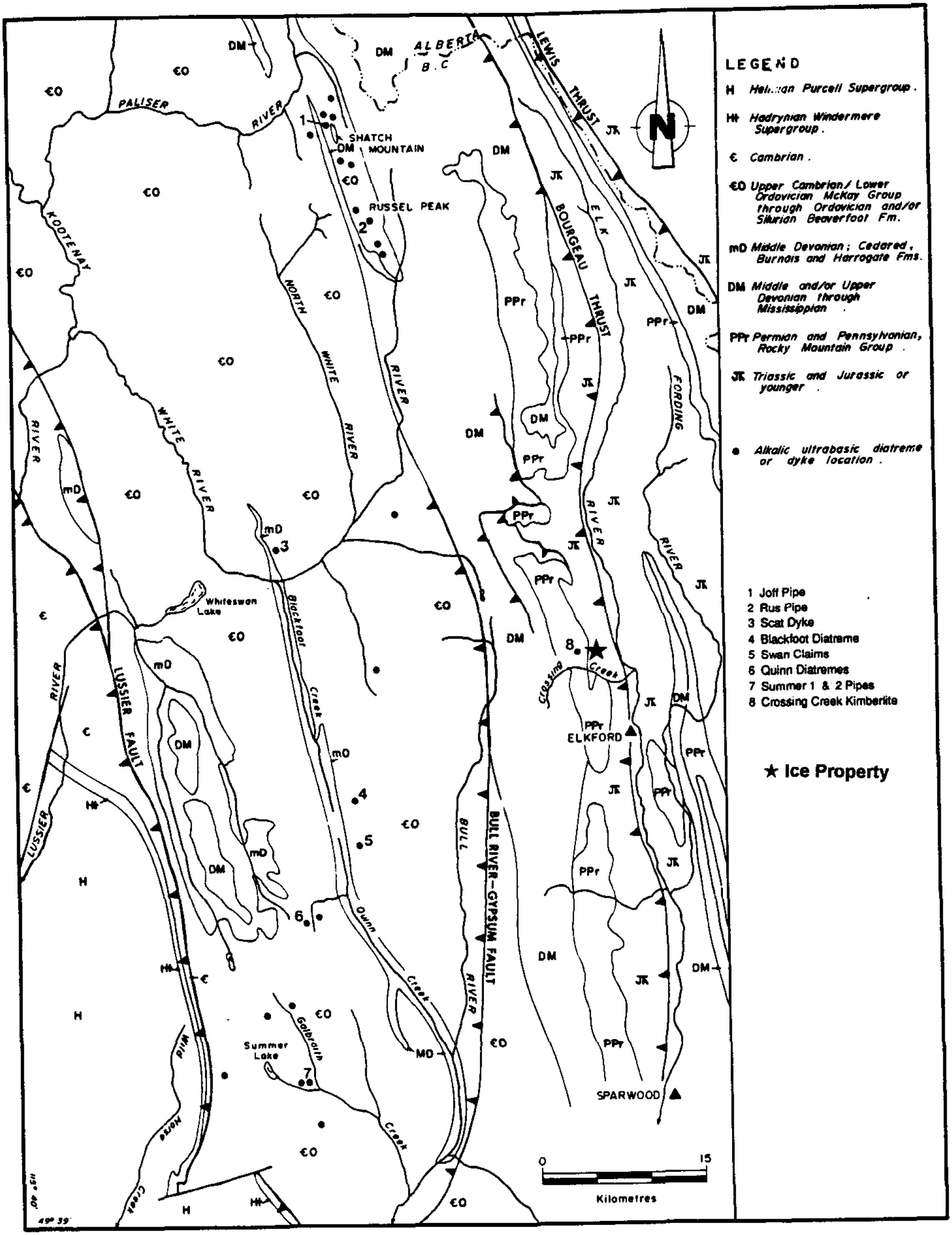


Figure 1 . General geology and diatreme locations in the Bull River - White River area. Geology modified from Leech (1960, 1979) and Price (1981).

From Pell (1987)

and $200 in the fourth and additional years, be carried out or cash paid in lieu to maintain the claims in good standing. Consequently, overall yearly assessment work requirements in the amount of $32,100 are required to keep the property in good standing. It is the author's understanding that Skeena Resources will shortly file assessment work and reorganize the claim structure of the property to bring the claims to a common anniversary.

Disclaimer

Taiga Consultants Ltd has searched the Province of British Columbia web based information site to establish the current characteristics and standing of the mineral claims listed above but makes no claim as to the veracity or accuracy of any information described herein. Taiga is not responsible for the filing of assessment work to keep the property in good standing.

Table 1 – Claims Status

Claim name	Units	Tenure #	Staked date	Anniversary	NTS
Standard Mining Corporation					
ICE 1	1	311076	29/06/92	29/06/2002	82G096
ICE 2	1	311077	"	"	"
ICE 3	1	311078	"	"	"
ICE 4	1	311079	"	"	"
ICE 5	1	311080	"	"	"
ICE 6	1	311081	"	"	"
ICE 7	1	311082	"	"	82J006
ICE 8	1	311083	"	"	"
ICE 9	1	311084	07/07/92	07/07/2002	82G096
ICE 10	1	311085	"	"	"
ICE 11	1	311086	"	"	82G096
Skeena Resources Limited					
ICE 23	15	371818	05/09/99	05/09/2002	82J006
ICE 34	10	371819	04/09/99	06/09/2002	82J016
ICE 37	20	371820	03/09/99	4/9/2002	"
GEM 1	1	310504	18/06/92	18/06/2003	82J006
GEM 2	1	310505	"	"	"
GEM 3	1	310506	"	"	"
GEM 4	1	310507	"	"	"
Standard Mining Corporation					
PIPE 1	1	310508	20/06/92	20/06/2002	82J016
PIPE 2	1	310509	"	"	"
PIPE 3	1	310510	"	"	"
PIPE 4	1	310511	18/06/92	18/06/2002	"
PIPE 5	1	310512	"	"	"
PIPE 6	1	310513	"	"	"
PIPE 7	1	310514	"	"	"
PIPE 8	1	310515	"	"	"
PIPE 9	1	310516	"	"	"
PIPE 10	1	310517	"	"	"
PIPE 11	1	310518	"	"	"
PIPE 12	1	310519	"	"	"
PIPE 13	1	310520	"	"	"
PIPE 14	1	310521	"	"	"
PIPE 15	1	310522	"	"	"
GTEN 1	1	310523	20/06/92	20/06/2002	82J006
GTEN 2	1	310524	"	"	"
GTEN 3	1	310525	"	"	"
GTEN 4	1	310526	"	"	"

Claim name	Units	Tenure #	Staked date	Anniversary	NTS
GTEN 5	1	310527	19/06/92	19/06/2002	"
GTEN 6	1	310528	"	"	"
GTEN 7	1	310529	19/06/92	"	"
GTEN 8	1	310530	"	"	"
GTEN 9	1	310531	"	"	"
GTEN 10	1	310532	"	"	"
GTEN 11	1	310533	"	"	"
GTEN 12	1	310534	"	"	"
GTEN 13	1	310535	"	"	"
GTEN 14	1	310536	"	"	"
GTEN 15	1	310537	"	"	"
GTEN 16	1	310538	"	"	"
GTEN 17	1	310539	"	"	"
GTEN 18	1	310540	"	"	"
GTEN 19	1	310541	"	"	"
GTEN 20	1	310542	"	"	"
C.B. Newmarch					
Kimberlite 1	20	385255	22/03/01	22/03/2002	82J005
Kimberlite 2	20	385256	"	"	82J006
Skeena Resources Limited					
Kimberlite 3	15	387205	18/06/01	18/06/2002	82J005,6
Kimberlite 4	15	387206	"	"	82J006
New Ice 12	20	377574	02/06/00	Forfeited	"
New Ice 13	18	377569	02/06/00	Forfeited	"
New Ice 13b	4	377582	02/06/00	Forfeited	"
New Ice 14	16	377577	03/06/00	Forfeited	82G096
New Ice 15	18	377570	02/06/00	Forfeited	82J006
New Ice 16	18	377571	"	Forfeited	"
New Ice 17	20	377572	31/05/00	31/05/2002	82J006
New Ice 18	20	377573	"	"	"
New Ice 19	5	377580	"	"	"
New Ice 21	18	377581	"	"	"
New Ice 25	20	377579	28/05/00	Forfeited	
New Ice 32	1	377583	31/05/00	31/05/2002	
New Ice 33	1	377584	"	"	
New Ice 34	1	377585	"	"	

Physiography

The topography in the region is moderately rugged with steep, but even, earthen eastern slopes and even steeper more abrupt, rocky west-facing slopes. The topography rises progressively steeper from 1350 m (4400') ASL at the Elk River and thence to 2000 m (6500') at the RAM-6 target on the east slope of the Front Range. The Bonus target lies 4 km (2.5 miles) to the west of the RAM-6 on a steep SE striking ridge spur at 2350 m (7700') elevation on a south-facing slope within the Front Range. Drainage is via seasonal creeks in V-shaped valleys, which are heavily forested. Creeks from the west slope drain into the East White River/Bull River, while east slopes drain into Crossing Creek or directly into the Elk River. Forests are primarily of coniferous trees composed of balsam fir, lesser spruce, pine, and larch. Marketable timber can extend as high up the slope as 2000 m (6500') although existing clearcuts extend only to 1700 m (5500'). The property is situated in the Continental Ranges of the Rocky Mountains, and is subject to heavy snowfall during the winter months. Snow begins to fall typically in late September or early October. Average rainfall is approximately 90 cm of which 30% falls in the form of snow.

DIAMOND EXPLORATION THEORY

A complete evaluation of the prospectiveness of a particular diamond exploration play is impossible without an understanding of general diamond theory. The following is a very quick overview of current understanding of the formation of diamond deposits.

Diamonds are formed deep in the earth's crust at very high temperature (>950°<1250°C) and pressures (50 kbar) typical of depths in the earth's crust of 150 to 250 km that are near the base of the lithosphere. Rock facies that are known to host diamonds include garnet harzburgite (olivine-orthopyroxene peridotite), lherzolite (olivine-orthopyroxene-clinopyroxene peridotite) and eclogite (garnet-clinopyroxene). Xenoliths of the previously mentioned source rocks are found within kimberlites and olivine lamproites, currently the only known hosts to economic diamond deposits. Kimberlitic and lamproitic magmas rise to the earth's surface at great speeds as small-scale gas charged diatremes which may form small volcanic complexes and build cones of ejectamenta. These magmas may also form small-scale dyke and sill-like breccia bodies within local host rocks below volcanic outlets. Xenoliths found in these rare rocks and the diamonds that they bear, are un-related to the kimberlite magma and are merely pieces of pre-existing ancient mantle torn up and incorporated into kimberlite magma during its rapid rise to the surface. The transport mechanism does not concentrate diamonds but merely acts to be the means by which diamonds reach surface as accidental inclusions. The source of xenoliths within the kimberlite, and therefore the source of diamonds must be from areas of the lithosphere that have temperatures sufficiently cool and of high pressure that diamonds can form and be preserved over long time periods. These conditions exist in cool mantle roots where the downward deflection of isotherms has caused a corresponding upward expansion of the diamond stability field. These conditions prevail in lithospheric roots under Archean cratons, the basis of "Clifford's Rule" (Janse, 1994) for diamond prospecting. Kimberlites and related rocks are the only known mechanism by which diamonds can be transported quickly enough to the surface to prevent the retrograde destruction of the diamonds back to graphite, the lower temperature form of carbon.

Exploration for, and evaluation of, kimberlites and related rocks revolve around the identification of minerals characteristic of harzburgites and lherzolites, and to a lesser extent eclogite, formed at the appropriate depths for diamond formation and preservation. These minerals are more numerically and volumetrically represented in diamond hosts than the diamonds being searched for and therefore provide an easier means to evaluate the probability of diamonds being transported to the surface successfully by the target diatremes. In general the minerals of interest include pyrope garnet, eclogitic garnet, chromite (spinel), the compositions of which, have much to say about the type of mantle which was sampled by an ascending kimberlite. Other minerals such as chrome diopside are characteristic of kimberlites in general, give indications of the source depth and can be used to locate kimberlites in exploration but say nothing about diamond potential. The compositions of ilmenite may indicate the oxidation state of the kimberlite during transportation to the surface and therefore the likely-hood of diamond preservation in a particular host.

Garnets which have compositions of high chrome (>2%) and low calcium constitute the G10 and G9 pyrope garnets, which are considered to be favourable indicators of diamond source rocks. The frequency and composition of pyropes are the main parameters by which kimberlites and lamproites are judged to be prospective for diamonds. To a limited degree the colour of pyrope garnets are indicative of their chemical composition with G9 garnets being port-wine in colour while G10 garnets have a deep purple hue (Schulze, 2000). In this way indicator minerals may give field recognisable indications of their contained chemistry. In general however mineral compositions are analysed by specialists, using electron micro-probe geochemical techniques. Once obtained, mineral compositions can be graphed onto charts with favourable fields outlined. These fields are derived from the compositions of minerals from known kimberlitic and lamproitic diamond producers. Common examples of these geochemical fields are as follows: Cr_2O_3/CaO (garnet), TiO/FeO (eclogitic garnet), TiO/Na_2O (eclogitic garnet), Cr_2O_3/MgO (spinel), Fe_2O/MgO (ilmenite). In this way the compositions of particular minerals may indicate whether or not a particular diatreme has significant potential to be an economic diamond host.

One of the exceptional difficulties of diamond exploration revolves around the conclusive identification of either kimberlite or lamproite and their discrimination from the other, numerous types of mafic diatremes that appear similar to these rocks. This is especially true within the cratonic margin area where the Elkford property is situated as there have been many other non-kimberlitic alkaline intrusions discovered in the region. Mitchell states "that kimberlites cannot be identified solely on a petrographic basis". A cut and dried definition of a kimberlite is therefore very difficult to arrive at, however in simplification (Kjarsgaard, 1996; Mitchell, 1986; Currie, 1996) the following points are crucial:

Kimberlite
- volatile rich ultrabasic rock (ie. carbonate rich)
- enriched in Sr, Zr, Hf, Nb, REE, Ni, Cr, Co
- inequigranular texture due to presence of macrocrysts ie. porphyritic
- kimberlite megacrysts suite of minerals (olivine, Mg-ilmentite, Ti-Cr-pyrope, clino-pyx, phlogopite, enstatite, zircon
- matrix minerals include second generation olivine + one or more spinel, ilmenite, perovskite, monticellite, apatite, phlogopite-kinoshitalite mica, carbonate, primary serpentinite
- ground mass olivines having iron contents less than Fo85
- modal orthopyroxene is unique to Kimberlite and Lamproite among alkalic rocks

Lamproites form a family or clan of rock types of which, only the olivine lamproites have significant diamond potential. Some important points from Mitchell and Bergman (1991) and Peterson (1996) are listed below:

Olivine Lamproite
- younger than 1.4 Ga
- phlogopite as a phenocrysts phase
- high concentrations of incompatible elements
- high weight % K_2O/Na_2O
- low CaO
- presence of high-Ti potassian richterite amphibole in the groundmass

- very high TiO_2 contents
- very high Ba content (>2000 ppm, commonly >5000 ppm)
- Forsteritic olivine
- Ti, Zr, Nb contents produce perovskite, priderite, shcherbakovite, wadeite which are diagnostic
- Ba & Fe rich sanidine feldspar in the groundmass, low Na
- zoned minerals with Ti and Fe enrichment and Al depletion in later phases
- absence of nepheline, melanite, melilite and primary plagioclase

It must be noted that the textural and composition appearance of kimberlites and lamproites is highly varied dependant upon the facies of rock encountered and the contained quantities of mantle xenoliths and crustal fragments within the intrusive. In the former instance a crater facies kimberlite will be volcanic or sedimentary in nature while a hypabyssal facies kimberlite will be igneous in nature and each facies type will have its own macroscopic and microscopic textures. In the latter instance a hypabyssal facies kimberlite will likely contain a large number of mantle xenoliths on macro and micro scales while a many diatreme facies kimberlites will contain abundant crustal wall rock fragments. In this way it may not be immediately possible to identify a kimberlite or lamproite for what it is without detailed petrographic and micro-probe analysis by experienced specialists.

Once a potential diamond host has been identified, sequentially larger samples are taken and processed to extract any diamonds within the favourable rock. Diamonds extracted are then graded as to size ie. macro-diamonds versus micro-diamonds (>0.5 mm), number of diamonds in each size class and then eventually diamond quality. Results are then reduced to a global carats/tonne grade, which is used to compare one diamond host to another. Eventually, with a sufficiently large enough sample a value per tonne (US$/tonne) figure is produced to ascertain the economic parametres of a particular diamond host.

The present state of diamond exploration theory is not static and this branch of geoscience is evolving very quickly spurred on by the discovery of economic diamonds in Canada in the 1990's. It is safe to say that current theory will undergo extensive expansion and revision in the near future.

The process of exploring for, identifying potential diamond bearing intrusions and developing an economic diamond deposit is a long and complex scientific endeavour requiring considerable financial and technical input.

REGIONAL GEOLOGY

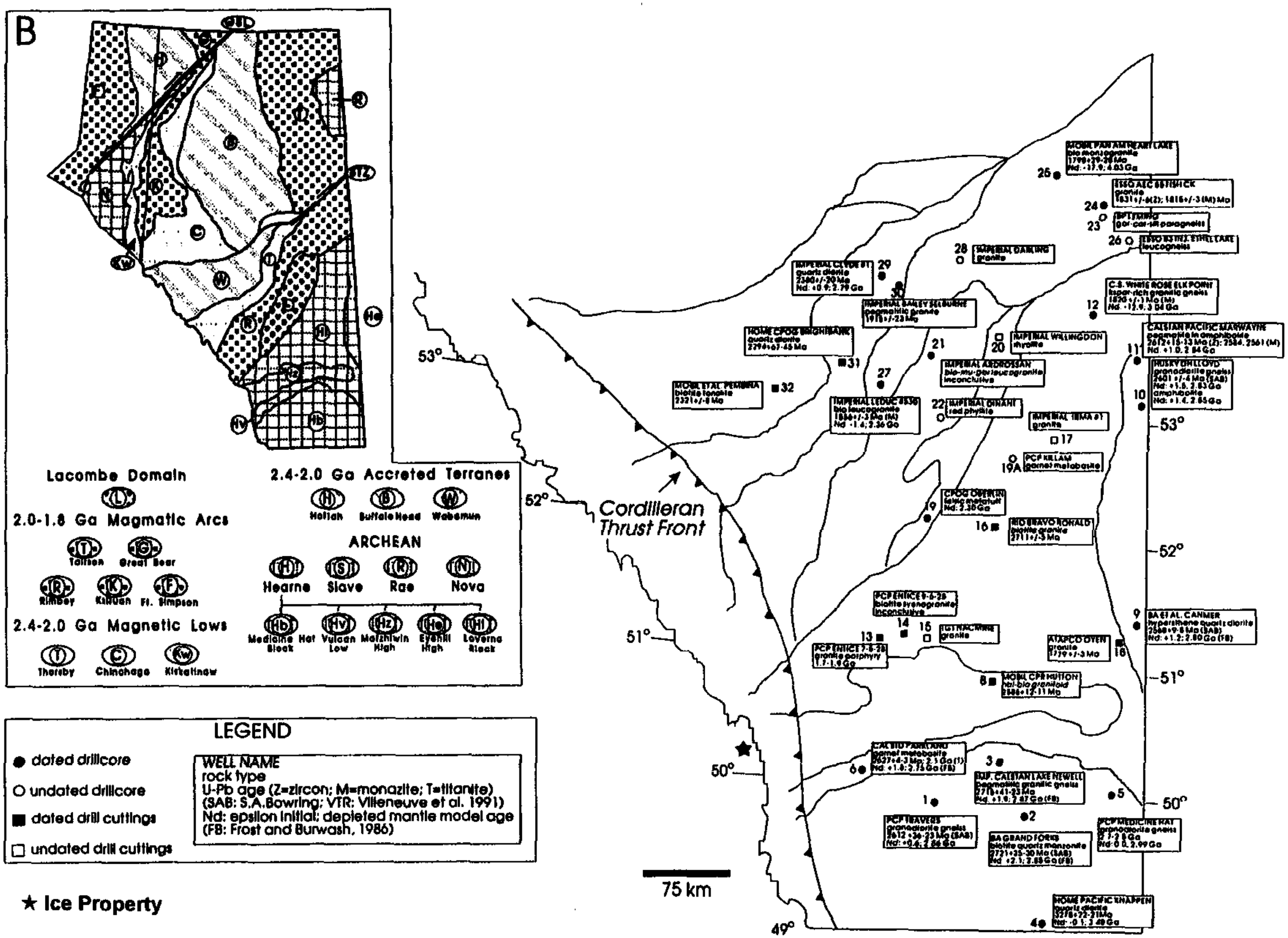
The Ice Claims are located within the Rocky Mountain Alkaline Belt (RMAB), a loose term encompassing a province of Paleozoic aged alkalic intrusions into the Rocky Mountain Foreland (Pell, 1986 and 1987). The RMAB contains a large number (greater than 40 depending on literature source) of diatreme intrusions of which at least three are known to contain diamonds (Allan, 2001) in the Elkford area. The diatremes are found in two main clusters of which the Ice property is located in the most southerly, the Cranbrook-Bull River cluster. The southern sector of the RMAB in the Elkford/Bull River area, within which the property lies, is situated within the Rocky Mountain Fold and Thrust Belt where southwest dipping upwardly concave thrust faults and associated folds developed during the Late Mesozoic Columbian Orogeny (Mid Jurassic to Tertiary). The Paleozoic platformal sequence of shallow marine carbonate and mature clastic rocks, and a wedge of terrigenous clastic rocks, were thrust to the northeast up the flank of the continental craton as a consequence of this orogenic activity (Price and Mountjoy, 1970).

The property is located 62 km east of the Rocky Mountain Trench in south-eastern British Columbia (Figures 1 and 2). The main property area, ie. east slope of the Front Range, is situated between the Bull River-Gypsum Thrust Fault to the west and the Bourgeau Thrust to the East. The trace of the latter essentially follows the course of the Elk River, north to south, along the main Elk River valley bottom. The general region around the Elkford area is underlain by a sequence of Devonian to Cretaceous aged marine succession of sediments that are succeeded by predominantly non-marine sediments after the Triassic.

Helmstaedt et al (1988) indicates that the Cross kimberlite on the west edge of the property, is hosted by Permian aged sediments of the Spray Lake-Ishbel Groups and Smith et al. It is reported that the intrusive has a Rb-Sr age date of 240-250 Ma (Smith et al. 1988), ie. Lower Triassic by the current time scale. He concluded that the intrusion predated the northeast transport of the Bourgeau Thrust sheet in which it is located. Smith et al (1988) reports that others have calculated that the eastward displacement of the thrust sheets in the area may be up to 100 km in distance. The RAM and Bonus diatremes are situated in a roughly similar topographic position to the Cross kimberlite, the former only two km to the east and the latter immediately adjacent to the Cross kimberlite.

As previously reviewed, the evaluation of the diamond potential of a particular diamond field hinges on the identification a number of crustal and lithospheric characteristics. The application of "Clifford's Rule" suggests that economically viable primary diamond deposits must be underlain by thick, Archean aged cratons called archons (Janse 1991). A recent examination of the potential of the Ice property, in light of current diamond exploration theory, has been undertaken by Chisholm (2001).

Exceptions (such as Argylle, Western Australia) exist to Clifford's rule however as a rule of thumb this selection criterion works reasonably well. In addition to this, it is assumed that the thickest portions of Archean lithosphere maintain a cool keel that promote preservation of diamonds in their stability field during transport to the surface from their site of residence in the lower mantle. Prospective areas with such keels are called "mantle-root friendly" A more detailed review of the current theories regarding the emplacement of diamonds can be found in Helmstaedt (1993).



From Villeneuve et. al. (1993)

Figure 2 . Summary map of the domain boundaries as mapped by this study. The domain boundaries are based upon the combination of aeromagnetic and gravity potential fields and U-Pb geochronology of material recovered from crystalline basement by hydrocarbon exploration wells. GSL = Great Slave Lake shear zone; STZ = Snowbird Tectonic Zone.

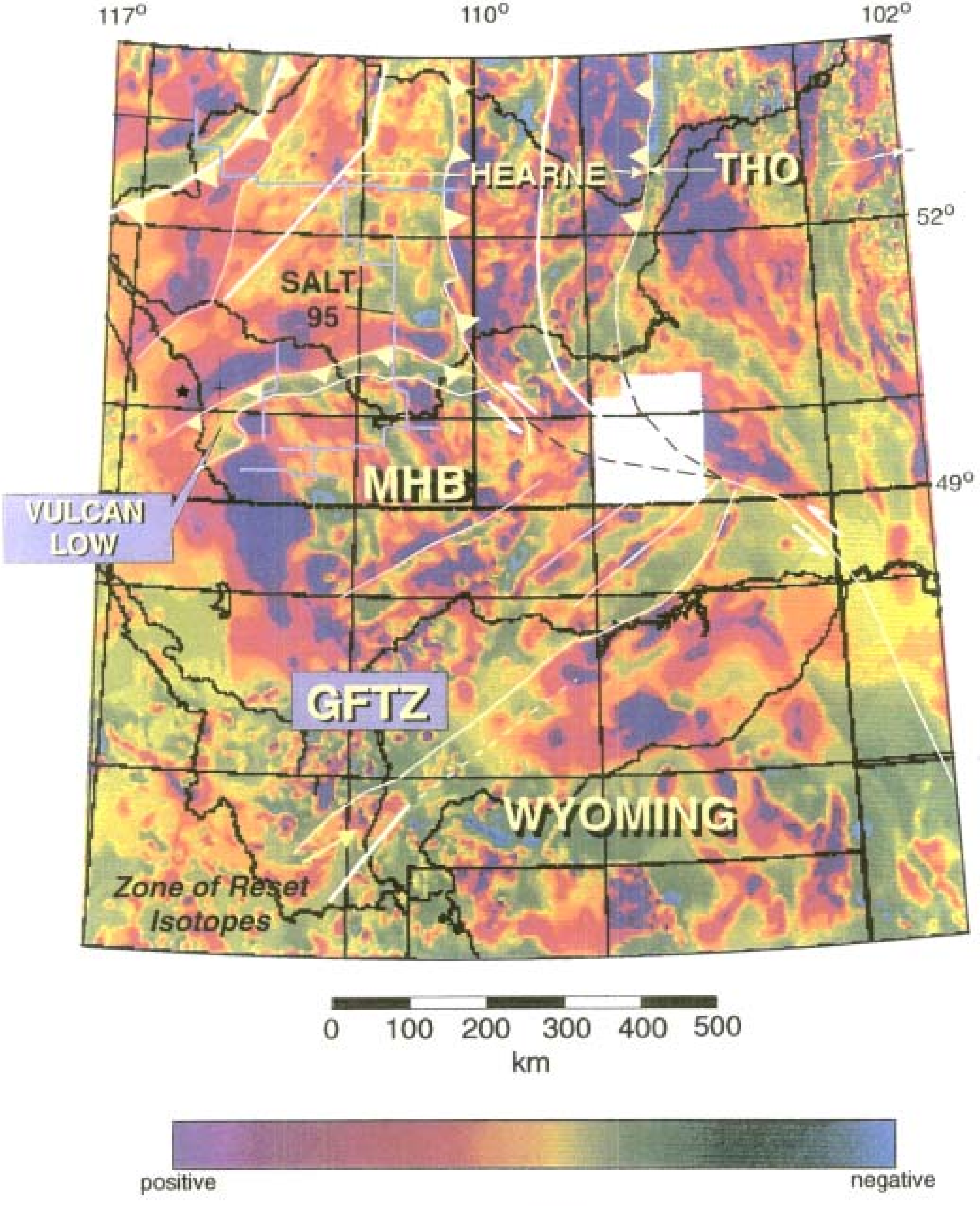
The basement in southern Alberta and southeastern BC region has been extensively studied in detail by the Lithoprobe Alberta Basement Transect, a research program co-ordinated by the Geological Survey of Canada. The conclusions of these studies have been detailed and summarised in a series of Lithoprobe reports within recent years as well as a recent Canadian Journal of Earth Sciences publication (Volume 37, No. 11, November 2000). These reports bring together aeromagnetic, magnetotelluric, seismic and isotopic data from basement cores to map the basement rocks according to tectono-staratigraphic and age divisions and so shed some light on the Ice Property's prospectiveness for diamonds.

It can be seen in Figures 2 and 3 that the Ice Claims fall within the Archean aged Hearne Province and more specifically within the Matzhiwin High Domain (MH) (Ross, 1997) immediately north of the Vulcan Low Domain (VL). The Matzhiwin High is characterized by a bulbous magnetic high which strikes east-northeast across southern BC and Alberta and has been interpreted as a magmatic belt (Ross et al., 1991) (Figure 3). Superimposed on the MH is a NE striking aeromagnetic fabric thought to result from penetrative deformation (Ross, 1995) and with evidence of lineations interpreted (Ross, 1995) to be structural features such as fault zones. There appears to also be a weak south dipping structural component within the MH that is cut off to the south by the Vulcan Low. The VL is considered to be a major south dipping suture or shear zone related to the Trans-Hudson Orogenic belt to the east. The basement stratigraphy within the larger region is truncated to the west by the Rocky Mountain Trench (RMT), although basement is known to underlie the Paleozoic sediments to the west of the RMT.

There is limited isotopic data available that can give a solid age date to the basement rocks of the Matzihwin High Domain. A single basement core date (Figure 2,Villeneuve et al., 1993) in central Alberta, within the MH, gives a 2.59 Ma age from a hornblende-biotite granitoid. When the author asked Dr. Gerry Ross of the Geological Survey Canada for his opinion on whether an age date for central Alberta within the MH could be extrapolated west to the Elkford area, he replied that he thought it could (Gerald Ross personal communication February 28,01). Other, indirect approaches have been made to date the basement in the BC portion of the MH. These studies have included age dating of zircons within the Elkford diatremes (Parrish and Reichenbach, 1991) and dating detrital zircons and monazite within basal arkosic units (Windermere SuperGroup) believed to be derived from the basement (Ross, 1995). The results of these studies have been inconclusive giving Paleoproterozoic ages, thought (Ross, 1995) to be "reflecting the effects of younger reactivation during Trans-Hudson collisions.

More recently (Lemieux et. al. 2000) the Matzihwin High and Vulcan Low areas have been termed together the Vulcan Structure that is interpreted to be the axial zone of a continental collision that formed during the south-dipping Hearne-Wyoming (Early Proterozoic age) collisional event. During this event the Medicine Hat Block to the south was thrust underneath the Younger Loverna Blcok to the north.

There is only very poor quality data available in regard to assessing the crustal and lithospheric thickness in the Elkford area. Ross (personal communication) indicated that he felt that the crust in



From Ross et al (1997)

★ Ice Property

Figure 7

Caption to accompany Figure 3

: Composite aeromagnetic anomaly map covering northern Montana, southeastern Alberta and southwestern Saskatchewan. The white area is the eastern half of the maple Creek survey which is presently being acquired through a GSC-Industry-Lithoprobe consortium. The western half of the Maple Creek survey area was acquired in 1996 through this same consortium and provides new data for the southwesternmost corner of Saskatchewan. The CAT 1992 and SALT 1995 lines are shown. The white lines correspond to domain boundaries with trhust polarities shown if known. Note the apparent truncation of the GFTZ (Great Falls Tectonic Zone) fabric by the southern TransHudson Orogen (THO) and the apparent confluence of the Eyehill High-Vulcan Low into the fabrics of southern THO. The bold solid line within the Hearne corresponds to the approximate axis of the Hearne structural culmination across which the vergence flips. The left lateral (sinistral) shear sense along the western edge of the THO is derived from studies of the exposed shield (Hajnal et al., 1995).

this area is approximately 50km thick however he indicated that the available data does not give any reliable idea as to the thickness of the underlying lithosphere.

Helmstaedt (1993) described the Cross Kimberlite of the Elkford area as having been emplaced "during normal faulting of older basement prior to its involvement in orogenic events" (page 56), i.e., the intrusion crosscuts bedding in the host sedimentary rocks at a high angle prior to their displacement by thrusting during the Columbian Orogeny.

A question to be addressed during discussion of the quality of the lithosphere under the Elkford field is "how much transport of the Bourgeau thrust sheet is there in relation to the present underlying basement", i.e., is the thrust sheet and associated diatremes still above its original basement? The answers to these questions are not easily arrived at.

Figure 4 from Pell (1987) is a section across the Rocky Mountain Foreland that shows the structural location of the RMAB diatremes in relation to the known thrust faults underlying Elkford, however it says little about the underlying lithosphere. Pell (1987) tried to assess the question of the prospectiveness of BC for diamonds and concluded that the "probability of British Columbia diatremes containing diamonds is low" because the location of the Cross kimberlite, the most easterly diatreme, is on the craton margin. This was however when the Cross kimberlite was the only known such intrusion identified in BC, was thought to be barren of diamonds and before the basement structure in the region was known. This was also before diamonds were discovered at the RAM 5, RAM 6 and Bonus kimberlite pipes (Allan, 2001) within the Ice Property and in the Golden Cluster diatremes (BC Minfile, Jack and Mark diatremes). Allan (2001) also reports that sampling by a previous operator returned a number of macro-diamonds from the RAM-5 and RAM–6 diatremes. It should be noted that the current understanding of the tectonic setting in relation to the basement is in a state of flux in Southern BC and previously made conclusions in regard to the basement must be assumed to be somewhat suspect today.

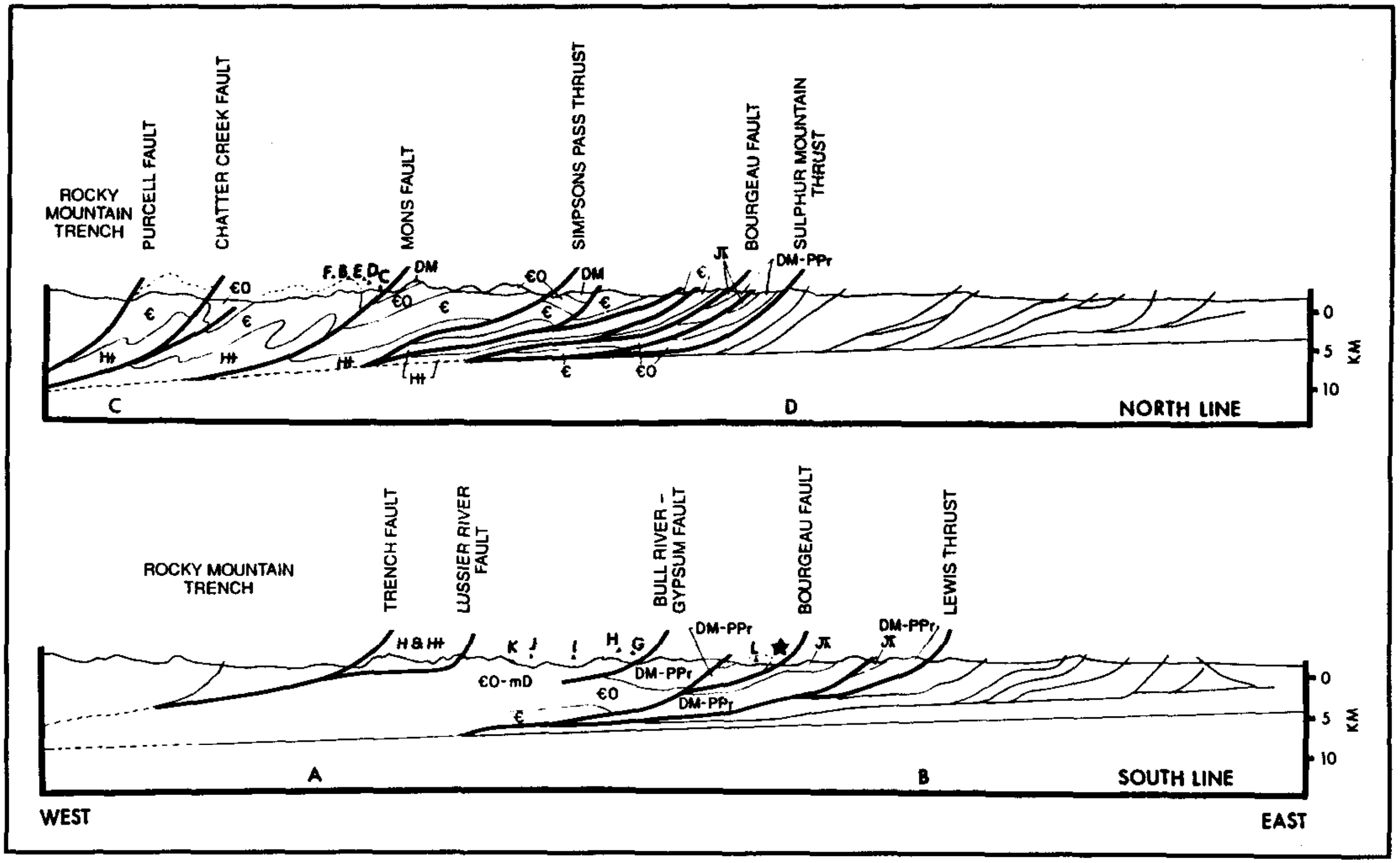


Figure 4 . Structural position of diatremes. B - Bush River; C - Lens Mountain; D - Mons Creek; E - Valenciennes River; F - HP pipe; G - Shatch Mountain; H - Russell Peak; I -Blackfoot; J - Quinn Creek; K - Summer; L - Crossing Creek. Geology modified from Wheeler (1963), Wheeler *et al.* (1972), Leech (1979), Price (1981).

From Pell (1987)

★ **Ice Property**

PROPERTY GEOLOGY

The property area is situated within the limits of Geological Map 1824A (G.S.C. -Price et. al. 1992) shown here as Figure 5. The main area of interest is underlain by sedimentary rocks of the following stratigraphic sequence: Etherington Formation of the Lower Carboniferous aged Rundle Group; Upper Carboniferous to Permian aged Rocky Mountain Supergroup; the Triassic aged Sulphur Mountain and White horse Formations of the Spray River Group; the Jurassic aged Fernie Formation as well as lesser amounts of Lower Carboniferous Mount Head Formation and Triassic Spray River Group. In general the sedimentary package consists of marine limestones, dolostones, calcareous silt and sandstones succeeded by the non-marine shales and siltstones of the Fernie Formation. Geologic field mapping for the property area is recorded as being completed in 1961, ie. prior to the discovery of most of the diatremes and kimberlites in the region. There are no dip symbols mapped within the area of interest and it is assumed that the geology of the area has been derived from airphoto interpretation without much supporting ground data. None of the various diatremes and other exotic intrusions are depicted on the Price et al. (1991) map.

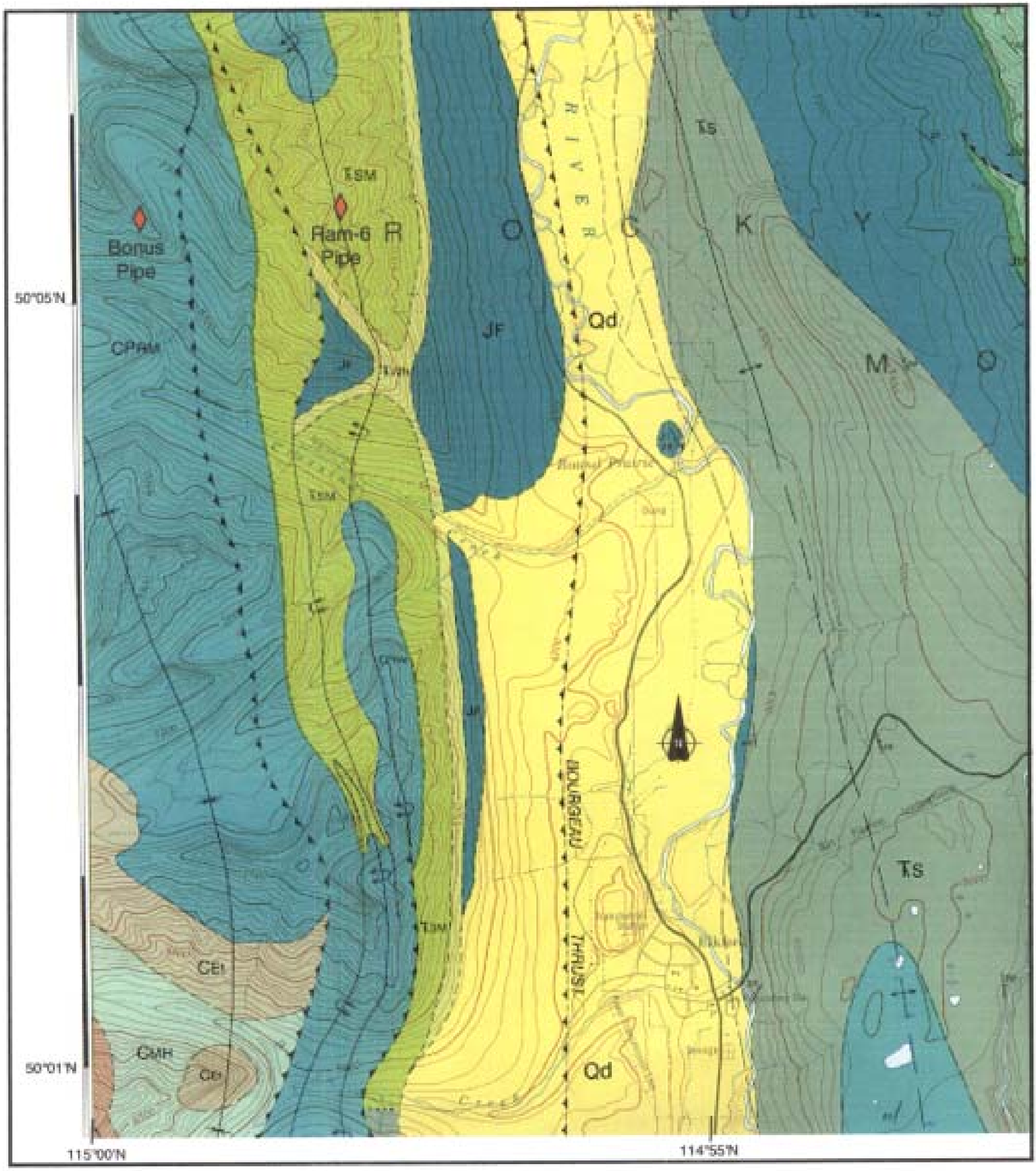
The Price et al. map shows the RAM diatremes as being hosted by the Triassic Sulphur Mountain Formation while the Cross kimberlite and the Bonus diatreme are shown as being hosted by the Upper Carboniferous to Permian aged Rocky Mountain Super Group (RMSG). The RMSG contains within it the Ishbel Group, which is the unit mapped by Grieve (1982) as hosting the Cross kimberlite.

The main area of interest, which contains the diatreme targets within the Ice Property, is situated close to the hinge line of an overturned anticline that plunges to the west. The Cross and the Bonus targets are mapped as west of the hinge line while the RAM-5 and RAM-6 targets are located on the hinge. At least two mapped, but un-named, west dipping thrust faults are located between the two areas of interest. The Cross-Bonus pipes are shown as hosted by the Rocky Mountain Supergroup dolomitic sandstones while the area of the RAM pipes is shown as underlain by Sulphur Mountain Formation siltstone, sandstone, dolomite and limestone.

A 1:20,000 scale compilation map (map #IC93HSS.DWG) in the possession of Skeena Resources Limited shows an overlay of geology which depicts the RAM targets as falling within the Spray River Formation of dark grey silty shale and argillaceous limestone. This map also shows the presence of a small "carbonatite" body on the north side of the Crossing Creek Valley, 3.5 km west of the main forestry road. Two "kimberlite dykes" are depicted 2.8 km west of the south end on the Elkford town site.

Grieve (1981) reviews some of the petrologic and chemical characteristics of the Cross kimberlite and reports on its structural position. He reports that Hovdebo (1957) mapped the intrusion as being hosted by crinoidal dolomite and dolomitic sandstone of the lower Ishbel Group and is overlain by the balance of the upper Ishbel Group. Grieve concluded that the kimberlite did not reach surface during emplacement. The intrusion is composed of several phases, all of which are sheared off at the eastern contact with the hosts rocks. A single chrome analysis of garnet from the intrusion "is greater than 2 per cent" indicating that it is a typical mantle derived pyrope however CaO was apparently not analysed for. Grieve reported that the groundmass of the intrusive is composed predominantly of

RC



From: Price et al, Map 1824A

0 2km
1:50,000

GEOLOGY OF THE ELKFORD AREA

Figure: 5

Legend To Accompany Figure 5

JF — *FERNIE FORMATION:* dark grey and black shale; grey siltstone and sandstone; limestone; phosphorite (nonmarine)

TRIASSIC

SPRAY RIVER GROUP (TSM – TWh)

TWh — *WHITEHORSE FORMATION:* calcareous and dolomitic sandstone and siltstone; minor sandy, quartzose dolomite; limestone; solution collapse breccia (marine)

TSM — *SULPHUR MOUNTAIN FORMATION:* calcareous and dolomitic siltstone and sandstone; silty limestone and dolomite; shale (marine)

TRIASSIC

TS — *SPRAY RIVER GROUP:* undivided, dark grey, silty shale; dolomitic or sideritic, argillaceous limestone

CARBONIFEROUS AND PERMIAN

UPPER CARBONIFEROUS AND PERMIAN

CPRM — *ROCKY MOUNTAIN SUPERGROUP:* light grey, quartzitic, dolomitic and calcareous sandstone; dark grey sandstone; silty dolomite; cherty dolomite; chert (marine)

CRMI | CRMS — *ISHBEL GROUP* and *SPRAY LAKES GROUP* (structure sections only)

LOWER CARBONIFEROUS

RUNDLE GROUP (CLi – CEt)

CEt — *ETHERINGTON FORMATION:* light grey limestone, cherty limestone, and calcarenitic limestone; dolomite; cherty dolomite; green and red shale; siltstone (marine) calcite with numerous opaques including ilmenite and magnetite as well as serpentine, mica (phlogopite), talc and accessory spinel and zircon. Inclusions in the groundmass consist of xenoliths of altered ultramafic rock, sediment rock fragments typical to the Paleozoic country rocks. Xenolithic material includes garnet and spinel bearing peridotite while xenocrysts consist of olivine, pyrope, chrome diopside, garnet. Ijewliw (1987) reports that the olivine within the intrusion is almost completely serpentinized and classified the xenoliths as spinel lherzolites. She also noted that the garnets have a range of colours from clear to pinkish brown, to pale green and have compositions in the pyrope-almandine-grossular range. Phlogopites are enriched in titanium and the intrusive contains both phlogopite and biotite. Of note is the fact that the Cross kimberlite does not exhibit a structural fabric save for a sheared western boundary. The compositions of garnets and chrome spinels were considered by Ijewliw to be indicative of higher pressure-temperature conditions than those of other diatremes in the RMAB.

Fipke et al (1995) summarises the geochemical results of indicator minerals from the Cross kimberlite as well the results of other diatremes in the eastern British Columbia area. The following points about the Cross were noted:

1) Chrome pyrope chemistry is indicative of very minor amounts of diamond from garnet harzburgite source rocks. Garnets plot close to the 85% line on Cr_2O_3/CaO field with only two garnets of G10 affinity and 71 garnets within the upper part of the G9 field.
2) Chromite indicates negligable potential for diamonds from a chromite harzburgite source. Cross chromites fall just below the Cr_2O_3/Mgo diamond inclusion field and have a wide range of values from 20 to 60% Cr_2O_3.
3) Chrome poor garnets show significant enrichment in Na (0.07 Na_2O) with 8 out of 13 grains showing this trend. None of the garnets were derived from eclogite sources. Geochemistry suggests that garnets are from "high pressure megacrysts" indicating that the kimberlite has sampled a lithospheric mantle keel sufficiently thick to contain diamond.
4) Ilmenites were too few to allow for any conclusions.
5) An overall assessment predicted that the Cross kimberlite did "not have a significant component of diamonds from any of the potential source rocks considered".

Schulze (1996) reports that Hall analysed two fresh xenoliths of garnet lherzolite from the Cross kimberlite that yielded equilibrium conditions outside the diamond stability field. Hall (1991) reports that the spinels were mantled by rutile and calcite grains are pseudomorphic after perovskite.

HISTORY OF EXPLORATION

The first mention of intrusive breccias in southeastern British Columbia is recorded by Hovdebo (1957) in a M.Sc. mapping thesis completed at the University of Saskatchewan. McCallum (1991) reports that Hovdebo worked on a "California Standard" field party in 1955 that made the initial discovery. A Cominco Ltd exploration party became interested in the intrusion in 1976 and identified the intrusion as a kimberlite. Roberts et. al. (1988) reports a "smaller satellite pipe" in close proximity to the original Cross kimberlite, no separate details on this intrusion are given however. Subsequently a large, regional exploration program was launched that was successful in discovering 41 additional diatremes. Further diatreme discoveries were made by Cominco, as well as a number of competitor companies, at this time, within the same region. The discoveries occur sporadically in an N-S band of 90 km x 20 km. Roberts et al. (1980) reports that only the initial discovery (Cross pipe) had "kimberlitic affinities" while the remaining diatremes were deficient in MgO and too highly alkaline (Al_2O_3, CaO) to be truly kimberlitic. These additional diatremes were also older in age being overlain by Mid Devonian strata ie. +380Ma suggesting that they are not related intrusions.

A petrographic report by Scott-Smith Petrography was completed on talus from the Cross pipe collected by J.Pell and/or C.E.Fipke. Scott Smith (1988) later confirmed by petrographic examination that the "Crossing Creek" was a "hypabyssal-facies opaque mineral (spinel)–rich phlogopite kimberlite". She verified that the sample was most similar to Group 1 kimberlites of southern Africa.

Subsequently at least five diatremes (Jack, Larry, Mark, Mike, HP,) were found 200 km to the north in the Golden cluster within Cambro-Ordovician sediments. Rb/Sr age dating suggests that they are Devono-Mississipian in age (334-348 Ma). At least two (Jack & Mark) returned small quantities of micro-diamond from initial bulk sampling. McCallum (1991) suggested that the diatremes have lamproitic affinities with the Jack breccias being most lamproite like.

The Mountain diatreme discovered further to the north in the Northwest Territories in a similar litho-structural setting, yielded six micro-diamonds from a 100 kg sample. Godwin & Price (1983) concluded that the diatreme was a kimberlite. Scott Smith (1988) later concluded that the diatreme is more likely a melilitite, a melilite bearing rock not related to kimberlite (Mitchell 1986, Pg 358).

Doctoral studies (Hall, 1991) of the Cross kimberlite indicate that it is composed of several discrete but related intrusions. The intrusions are characterised by having a large percentage of mantle derived xenoliths that were identified as primarily "altered spinel peridotite". The mineralogy and mineral compositions of the mantle xenolith suite are indicative of derivation from Mg-rich, depleted peridotite mantle that has subsequently been metasomatically enriched. Low calcium, G10, garnets constitute 2% of the garnet suite. Cominco apparently took a bulk sample from the Cross pipe however the sample results are not in the public domain and it is not known if the sample returned any diamonds. Helmstaedt (1993) listed the Cross kimberlite as having a "barely visible" mantle root signature. This was later confirmed by Fipke et al (1995) as detailed in the previous section of this report.

A private group of property owners completed a program of heavy mineral sampling in Crossing creek searching for potential diamond placer material in 1993. Consolidated Ramrod Gold Corp completed in 1993 an independent evaluation of the existing claims by taking soil and stream sediment samples, looking for additional kimberlite occurrences (Anderson, 1999). In 1994 Prof. M.E. McCallum of Colorado State University examined the concentrates derived from the 72 stream sediment samples collected by Ramrod in 1993. He reports that G9 pyrope garnets were identified and that this was judged to be "encouraging" and so additional 1/2 yard sized samples were collected and processed by Ramrod to produce pyrope garnet, chromite and ilmenite concentrates that were also sent to Colorado for micro-probe analysis. This work let to the discovery of "four" new "kimberlite" (RAM-5, RAM-6, RAM-6.5) diatremes in the Elkford area as well as indicated the presence of additional undiscovered diatreme bodies. The author surmises that the Bonus pipe was considered a new discovery. Anderson (1999) indicates that the personnel of Quest International Resources Corp (successor to Ramrod) and Prof. McCallum believe the new diatremes to be kimberlites.

A sluice box separation of a ½ yard sample of RAM-5 pipe is reported (Anderson, 1999) returned a single macro diamond. Additional ½ yard samples were taken from the Bonus and RAM-6 diatremes and these were subsequently processed by Saskatchewan Research. A macro-diamond recovered in this phase of work was recovered but due to the fact that the samples were mixed, provenance of the diamond apparently cannot be traced to an individual pipe.

A DIGHEM-5 EM survey was completed on the "Elkford Properties" by Dighem Surveys and Processing Inc for Consolidated Ramrod in 1994.

An exploration program was launched in 1996 by Quest International which involved the construction of a 4 km dirt road into the RAM-5,6, and 6.5 targets. Ninety tons of samples of surface material were collected from trenches (RAM-5, 35 tons, RAM-6, 15 tons, RAM-6.5, 40 tons) and shipped to Fort Collins, Colorado for milling and testing under the supervision of Prof. McCallum (McCallum, 1996). The samples were reported to have been highly diluted by up-slope non-diatreme material. The highest concentration of kimberlite indicator minerals was reported coming from RAM-6.5. A total of six diamonds were recovered from the samples (RAM-5, 3 good quality stones up to 0.185 carat, RAM-6.5, 3 poor quality stones up to .02 carat).

Skeena Resources optioned the property in 1998 from Quest International Resources Corp. (Ramrod's successor company) and completed a rock sampling program over the Bonus (177.79kg), RAM-5 (89.11 kg) and RAM-6 diatremes (89.23 kg). The samples collected were treated by the Lakefield Research Limited laboratory in Ontario by caustic dissolution and magnetic separation to produce a concentrate (Jago 1999). The concentrate was microscopically examined and the resulting mineral species separated. The Bonus and RAM-5 samples returned diamonds while the RAM-6 sample was barren. The Bonus sample returned six, white, transparent diamond fragments with a total weight of 0.001 carat and a maximum long dimension of 0.48 mm ie. all within the microdiamond size classification. The RAM-6 sample returned one tetrahexahedral, partially distorted, white, transparent diamond with 0.17 mm longest dimension with a weight of 0.000020 carats.

Subsequently, Skeena completed a helicopter supported stream sediment sampling program over the whole property in 1999. Taiga Consultants Ltd. completed the field work and forwarded the samples to Loring Laboratories of Calgary where heavy mineral concentrates of these samples were prepared. Loring forwarded the concentrates to Skeena in Vancouver. Skeena later sent these concentrates to M.E. McCallum for microprobe analysis (McCallum, 2000) resulting in the identification of G10 and 9 garnets and chromites that plotted within the diamond inclusion field. These results define additional targets in addition to those identified in 1996. Subsequently in 2000 a ½ kilometre access road was built into the Bonus pipe as a spur from the previous Cross kimberlite road and the dirt overlying the intrusion was stripped and levelled by back-hoe in preparation for a future drill program.

2001 WORK PROGRAM

Taiga Consultants Ltd was previously requested by Skeena Resources to complete a literature assessment of the nature of the underlying lithosphere of the area around Elkford (Chisholm, 2001). In summary this report concluded that the basement under the area probably has a similar Archean age to that of central Alberta and that there is evidence of northeast trending faults and an east-west deep seated suture within the basement. It could not be determined however what the thickness of the underlying lithosphere was and so it could not ascertained whether the Elkford area satisfies completely the requirements of Clifford's Rule for diamond prospectivity.

Subsequently, Skeena Resources contracted Taiga Consultants Ltd to supervise a diamond drill program of the RAM-5, RAM-6 and Bonus targets. LeClerc Drilling of Cranbrook was contracted by Skeena to carry out the diamond drilling utilising a skid mounted Longyear 38 diamond drill and to complete associated drill pad construction using a D-6 Caterpillar bulldozer. A total of five NQ holes (427.33 m) were drilled during the program with three being completed at RAM-6 and the balance at RAM-5. It was found that due to the recent extended drought in the area that there were no convenient water sources within pumping distance of the either the RAM or Bonus sites. Water was collected from the Elk River using a surplus US army 6X6 tanker truck with 1500 litre capacity and trucked to the RAM sites. The excessively steep road resulted in numerous breakdowns in the running gear of the truck and necessitated long unproductive delays while waiting for water. The truck was otherwise in good condition and so any future drilling will require a more specialised type of vehicle designed for the rigors of this type of work. It was also found that it was difficult to construct optimal drill pads with the caterpillar in the steep terrain and that it was difficult to manoeuvre such a large drill rig in the confined spaces available. In future it would be more useful to contract the services of a medium sized back-hoe for pad construction and final positioning of the rig.

The drill core was moved every afternoon at the end of drill-shift to the Hi-Rock Inn in Elkford and kept under lock and key in their garage. The core was then logged and photographed by the author on a daily basis. On completion of the drilling, the core boxes were shipped to a facility outside of Cranbrook to be split and sampled. Splitting was completed immediately by the author, using a sledge and brick-chisel in the core box. A half split was kept in the box and is retained in a rented, sheltered core-rack at the SuperGroup Holdings facility on the Vine property. The facility is located on the Hidden Valley road, 10 km south of Cranbrook.

The core was sampled in approximate 5 kg sample sizes (roughly 3 metres of core) in plastic bags, then weighed on an electronic balance. Each sample interval was labelled as to hole #, interval in metres, weight and total calcite content. Samples were then placed in five-gallon pails and shipped by pickup truck by the author to the Taiga Consultants Ltd storage facility in Calgary and held under lock and key. Once a processing laboratory was chosen and a processing date scheduled, all of the samples were sealed into their pails and packaged on a pallet and shipped by commercial transport truck (January 16, 2002) to the Kennecott Exploration Canada laboratory in Thunder Bay, Ontario. The Kennecott laboratory completed caustic fusion on the 221 kg shipped.

The steepness of the Crossing Creek road into the Bonus target precluded trucking drill water into the site, and so it was decided to take a bulk sample for analysis in place of the previously planned drilling program. Minconsult of Vernon, BC was contracted to drill and blast using a diesel/air portable pneumatic hammer at a central point within the previously prepared drill pad previously constructed in November 2000. A 4x4 metre trench was excavated (Figure 6) to a depth of one metre and a sampled collected by hand that filled 6 large (89x104x150 cm dimension) T104 "super-sacks". The sacks were subsequently airlifted out to a waiting truck at the forestry gate and then transported to Elkford, where they were unloaded into a locked chain-link paddock behind Don Curry's Gas+ gas station. An A-star, helicopter from Big-Horn Helicopters of Fernie, BC was used to provide air support. The resulting mini-bulk sample was estimated to weight 3500 kg. The sample was shipped by Dolfo Transport (January 10,2002) to the Ashton Mining of Canada Inc laboratory in North Vancouver for "Dense Media Separation" (DMS) processing in order to extract any diamonds in the +0.5-6.0mm size range. The results of this work will be reported later in this report.

In addition to the diamond drilling a small amount of geologic mapping was completed on the RAM-5 and RAM-6 targets. Two man-days were spent completing detailed reconnaissance style magnetic surveying on the roads in the vicinity of the RAM targets.

The RAM-6 and RAM-5 diatremes were test surveyed along the road using a sensitive magnetometer and found to have a magnetic response indistinguishable from the surrounding sedimentary bedrock.

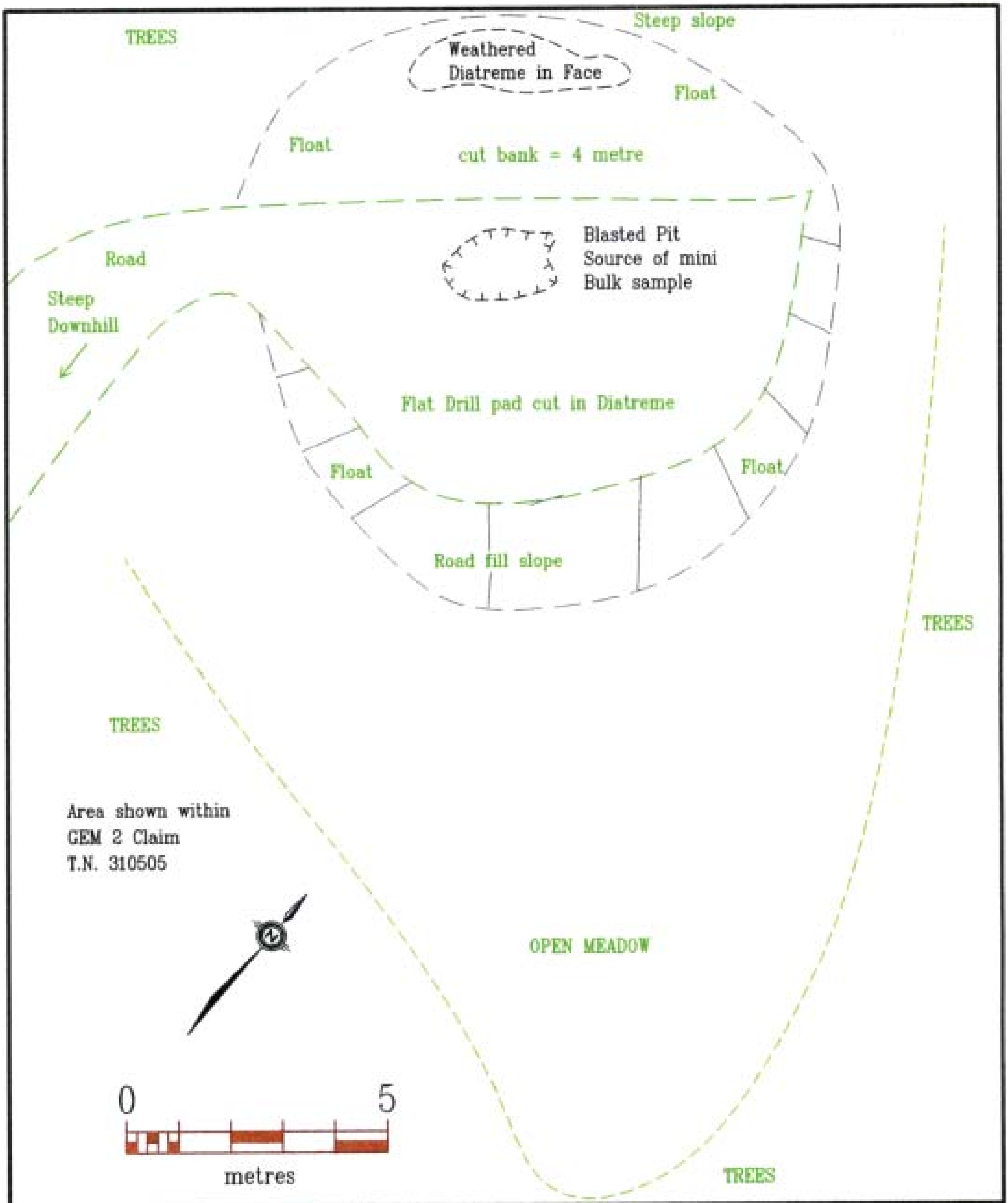
A number of large hand samples of diatreme material were collected on the Bonus and RAM-6 intrusions by the author, for preparation of 65 thin sections prepared by the Mount Royal College of Calgary, Alberta. Some of this material (four Bonus thin sections) has been farmed out to Bruce Kjarsgaard of the Geological Survey of Canada for academic study purposes. The majority of the thin sections (59) were sent to Prof. M.E.McCallum for commercial petrographic analysis and his observations are reviewed in this report. Several hand specimens of the Bonus diatreme were sawn and highly polished in order that the internal textures and mineralogy could be observed.

Results

Bonus Diatreme

The Bonus diatreme consists of a small intrusion located on a SE striking ridge roughly one hundred metres east of the Cross kimberlite. Originally the intrusion was only known from weathered material observed in a small hand dug pit (Rupert Allan, pers.comm.). Subsequently the site was excavated using a large backhoe to cut the site down to a level platform with dimensions of roughly 10m X 12m. The intrusion now outcrops on the cut bank on the NW side of the platform and within the platform itself (Figure 6). A total of 51 thin sections were made up from large hand samples collected from the site.

It can be seen in outcrop that the rock is characterised by moderately advanced but shallow, greenish-yellow weathering and is dark greenish-grey on fresh surfaces. In general the intrusive is fine-grained, porphyritic with biotite/phlogopite phenocrysts up to one centimetre and exhibits an abundance of



ICE PROPERTY Plan of BONUS Diatreme			Taiga Consultants Ltd. Skeena Resources Ltd.		
Date: Mar.21/2002	Project: 707	Scale: 1:100	N.T.S.: 082J.006	Mining Div: Fort Steele	Figure: 6

dark coloured nodules, mafic xenoliths and fragments of country rock. The latter are primarily sandstone and limy sediments and comprise less than 15% of the rock volume. Mafic xenoliths comprise roughly 5 to 10% of the rock volume while nodules are much more numerous at roughly 20% although this is likely an understatement as a polished hand specimen appears to be composed of closely packed fine-grained pellets. Individual nodules vary in size from less than one centimetre up to 8 cm and show concentric zoning around nuclei composed variously of mafic xenoliths, macrocrysts and country rock fragments. Nodules often incorporate other, earlier nodules of the same lithology and would be classified as nucleated autoliths (Mitchell, 1986). The matrix contains variable amounts of carbonate and reacts strongly to the HCL test. On polished section the matrix has a slightly brownish green-grey hue and will here be termed kimberlite. The rock is weakly magnetic with a strong but variable dusting of opaque minerals. Orange garnets were rarely observed in hand specimen and are outnumbered by shiny black pyramidal opaques that appear to be ilmenite or chromite. While the author did not complete petrographic descriptions of the 46 thin sections he did view the thin sections under petrographic microscope, binocular microscope (transmitted light) and the oversized dimensions of many of the sections allowed for a close, un-aided visual observation in bright daylight. Many of the mafic xenoliths are peridotite composed of glassy well-fractured olivine showing dustings of black opaques along fracture lines. Many of the olivine have partially altered to serpentine and opaque minerals (likely magnetite) with the opaques ringing individual olivine grains in a "bastite texture. In several sections a dark resinous green-brown mineral interstitial to olivine appears to be a type of orthopyroxene. It was noted that fresh appearing olivine made up 5–15% of the matrix as individual crystals (microphenocrysts), crystal fragments and small rounded nodules. Both olivine macrocrysts and mica often show a corroded outline indicating that they are not in equilibrium with the kimberlite magma and are being resorbed. A less common, dull appearing, fine-grained, amorphous bluish-green mineral is found as the nucleus of several nodules and as a finely disseminated alteration mineral that is possibly arfvedsonite an alkalic amphibole. Micas are typically highly pleochroic (straw to deep orange). Rare scattered equant crystals of bronzy green minerals exhibiting chatoyance are likely orthopyroxene macrocrysts enclosed in the matrix. A highly refractive, dark orange coloured, pyramidal mineral is found within peridotite xenoliths and is likely sphene.

In several of the polished hand specimens port wine coloured garnets can be observed under strong oblique light. In two instances garnets macrocrysts were positively identified. One is a 2mm rounded grain with a kelyphitic rim while the second is a fresh 2 mm equant crystal with no rim. Both have a colour, which compares to that of Schulze's (2000) photograph of G9 lherzolite garnets from the Roberts Victor mine in South Africa. In a third instance a red mineral was observed disseminated in a large (3 cm) rounded ultramafic xenolith. Unfortunately all of the red grains are altered (kelyphitic alteration?) to the point where it is difficult to make a positive mineral identification. It is likely that the mineral grains are pyrope garnets similar to the garnets macrocrysts observed in the matrix.

Rarely, the larger nodules exhibit tails suggesting that in part at least some of the nodules are ejectamenta. Some of the thin sections and portions of the hand samples were observed as being, packed with rounded pellets with diameters of less than one centimetre. These small pellets often do not contain obvious exotic nuclei and are probably pelletal lapilli. Mitchell (1986) states that the pellets form from disruption of the magma after crystallisation. The presence of lapilli seems to indicate that the current level of erosion is close to the previous paleosurface and that the diatreme reached surface, a conclusion which, is different from that arrived at by previous authors for the adjacent Cross kimberlite. Given the presence of pellets, the out-cropping rock would best classify as diatreme facies as defined by Mitchell (1986). As will be seen later in this report, the petrographic examination of McCallum contradicts this conclusion as he assigned the Bonus to hypabyssal kimberlite facies.

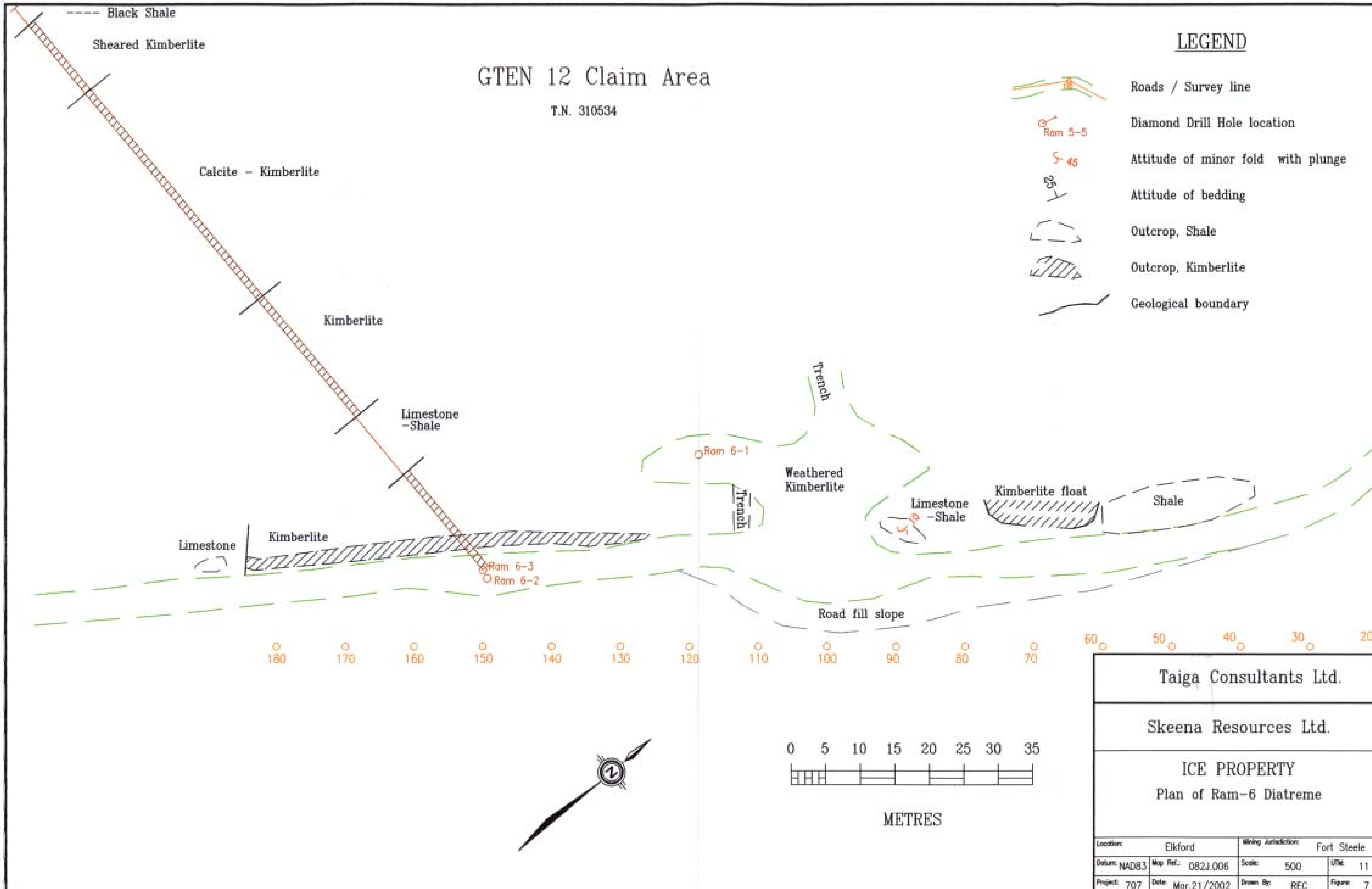
Neither the hand samples collected nor the thin sections show sign of obvious structural fabric and the fresh rock is very competent. This may indicate that the Bonus pipe is younger than the Columbian orogeny that effected the surrounding host rocks. The rock is competent and takes a very high polish.

RAM-6

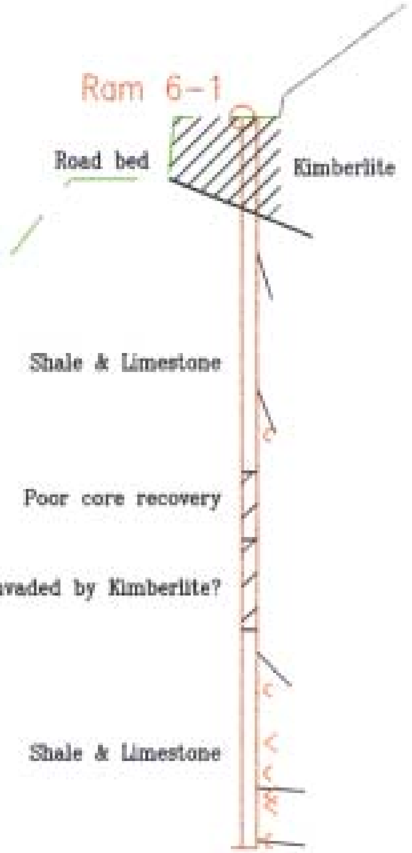
The RAM-6 diatreme (which includes the former RAM-6.5) is referred by McCallum (1996) as kimberlite and so will be identified as such in this report. The kimberlite outcrops over 90+ metres in the cut-bank of the RAM access road just before its termination at 2030 m (6665') elevation. The road-cut was geologically mapped and is shown in Figure 7.

Most of the previous sample trenches at the site are slumped in and/or are obliterated by the recent drill pad construction. For the most part the rock is highly weathered to dark green, greasy unconsolidated mud. Original textures can be seen in fresh cuts in outcrop where clast types could be identified and even rounded mafic xenoliths could be observed. As discussed, the outcrop does not form competent rock except where resistant clasts within the breccia weather out or where boulders of altered (silicified?) breccia were observed as float. Some of the resistant clasts are composed of well rounded, fine-grained, purple coloured mica porphyry termed lamprophyre, by this author, that when cracked emitted a remarkably heavy sulphur smell.

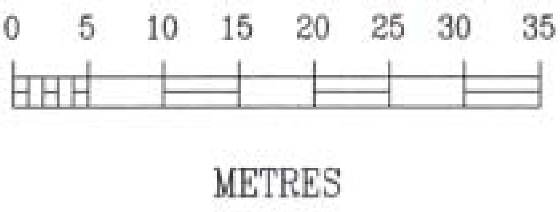
The RAM-6 diatreme was drilled in three holes and all three incorporated kimberlite intersections. The first drill-hole (RAM-6-1) was drilled vertically and intersected diatreme from surface to 8.90m (Figure 8). At that point the hole encountered a mixed section of limy shale and limestone until its total depth of 48.50m. The diatreme is composed of weathered pale yellow-green, matrix supported breccia containing roughly 30% angular to moderately rounded host rock fragments (predominantly shale and limestone). Among the fragments are small particles of coaly mudstone and dark shiny coal. The matrix is aphanitic with approximately 4% medium-grained black to dark brown mica phenocrysts and roughly 3% limonitic spots. The latter are likely pseudomorphic after olivine and/or orthopyroxene. The contact with the host rock is sharp with a dip of 62°. The matrix returns a weak reaction to HCL attesting to the presence of carbonate, while being non-magnetic. The core is quite incompetent and core recovery is often incomplete. Below the main diatreme intersection is a section (23.62-34 m) where recovery is low and the sedimentary host rock is extensively crackled and brecciated. This section appears to be invaded by narrow dyklets of green-yellow-orange coloured fine-grained diatreme material however identification is not possible due to the advanced weathered state of the core. This suggests that the core axis is in close proximity to an adjacent diatreme body.


GTEN 12 Claim Area
T.N. 310534
---- Black Shale
Sheared Kimberlite
Calcite - Kimberlite
Kimberlite
Limestone -Shale
Limestone
Kimberlite
Ram 6-3
Ram 6-2
Ram 6-1
Trench
Weathered Kimberlite
Trench
Limestone -Shale
Kimberlite float
Shale
Road fill slope
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
LEGEND
Roads / Survey line
Ram 5-5
Diamond Drill Hole location
45
Attitude of minor fold with plunge
25
Attitude of bedding
Outcrop, Shale
Outcrop, Kimberlite
Geological boundary
0 5 10 15 20 25 30 35
METRES
N
Taiga Consultants Ltd.
Skeena Resources Ltd.
ICE PROPERTY
Plan of Ram-6 Diatreme
Location: Elkford
Mining Jurisdiction: Fort Steele
Datum: NAD83
Map Ref.: 082J.006
Scale: 500
UTM: 11
Project: 707
Date: Mar.21/2002
Drawn By: REC
Figure: 7

Section Facing Az. 225°



Dip = -90°
Az. = Vertical
E.O.H. = 48.50m



LEGEND

- Roads / Survey line
- Diamond Drill Hole location (Ram 5-5)
- Open fold
- Tight fold
- Attitude of bedding in hole
- Well bedded limy shale and limestone of the Triassic Aged Sulphur Mountain Formation
- Kimberlite diatreme
  K = Kimberlite dyke
- Geological boundary

Minerals of Interest

gt	Garnet
cd	Chrome diopside
br	Bronzite orthopyroxene
ov	Olivene or olivene macrocrysts
py	Pyrite

Taiga Consultants Ltd.

Skeena Resources Ltd.

ICE PROPERTY

Drill Section DDH Ram 6-1

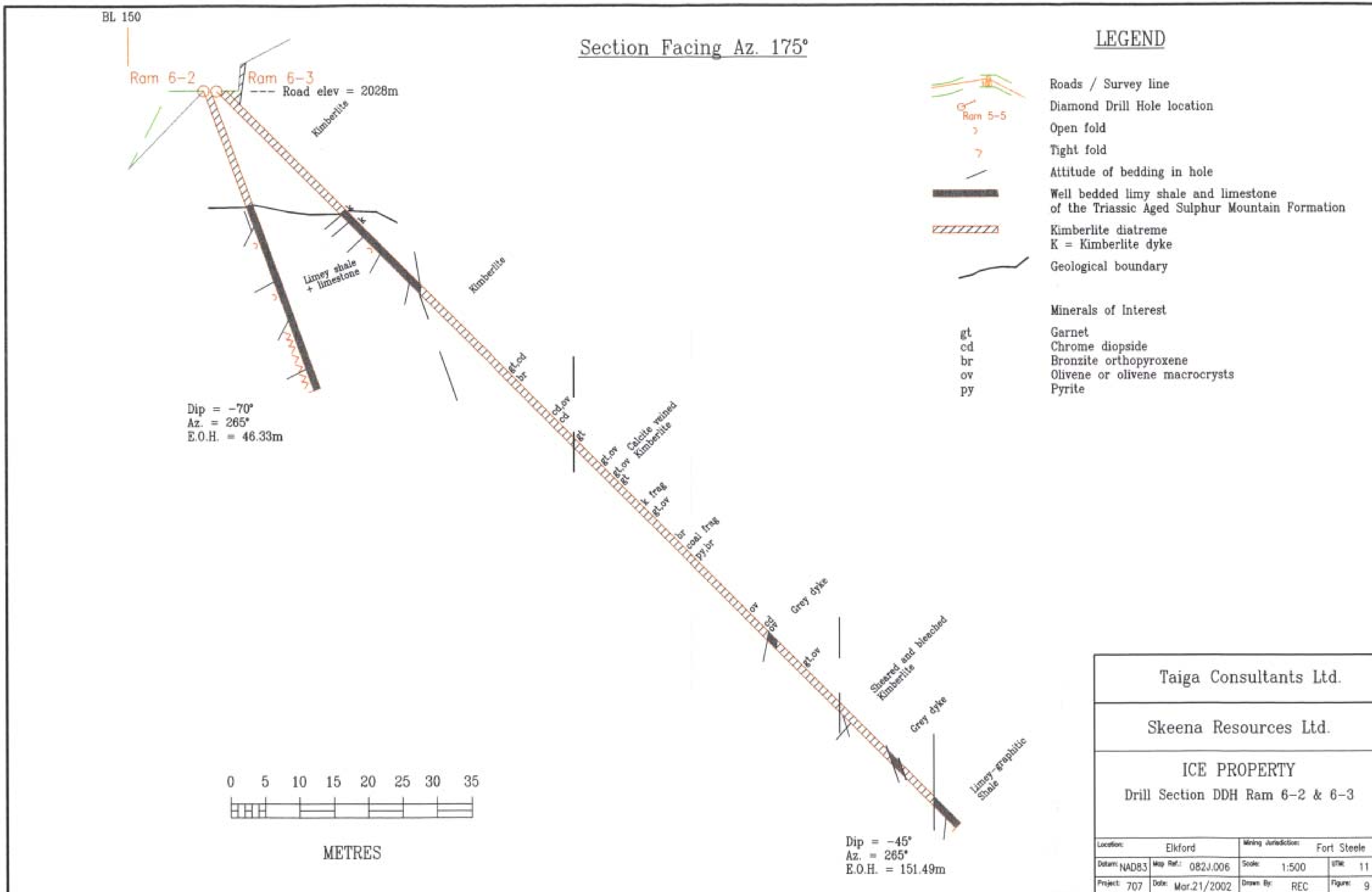
Location: Elkford		Mining Jurisdiction: Fort Steele	
Datum: NAD83	Map Ref.: 082J.006	Scale: 1:500	UTM: 11
Project: 707	Date: Mar.22/2002	Drawn By: REC	Figure: 8

Hole RAM-6-2 was drilled 35 m to the south of RAM-6-1 (Figure 9) at an inclination of -70° to the west. The hole was drilled on the road in an area where the cut bank is composed of diatreme material and intersected diatreme from surface to 17.95 m. For the most part the intersection is very similar to that in drill-hole RAM-6-1, however the core is somewhat less weathered and more competent. As well the matrix has a strong clay component and returned a moderately strong HCL reaction indicating at least 5% carbonate content. Rare sections of core are very weakly magnetic. Within the host rock from 17.95 to 46.33 m (T.D.), the shale is extensively folded into open, minor folds with flat fold-axes at right angle to core axis.

Hole RAM-6-3 was drilled from the same set-up as RAM-6-2 at an inclination of -45° (Figure 9). The result was essentially the same as RAM-6-2 with a diatreme breccia from surface to 24.50 m. From 24.50 m to 41.82 m there is a section of grey shale with two narrow (0.27 and 0.20 m) intersections of diatreme breccia. At 41.82 m however there is a second major intersection of diatreme breccia that extended down to 147.05m. From this point to 151.49 m (T.D.) the hole intersected graphitic limy shale. In general the core in RAM-6-3 is more competent than that in the first two holes and more features can be made out upon inspection. The upper section is composed of matrix supported breccia with 20-50% obvious host rock fragments of limy shale, coal, limestone, and mudstone. Several rounded, limonitic, mafic xenoliths up to 2 cm in size were noted close to the lower contact. The lower, 105.23 m thick, diatreme intersection is somewhat different from the previous intersections described. Sedimentary fragments are more numerous averaging roughly 30-40% of volume and have a wider size variation up to 10cm and the lithology types are more numerous with pale green mudstone, oil shale, quartzite, green shale, pyrite and rare kimberlite in addition to those previously mentioned.

Of interest is the fact that in one thin section a particle of "wood" was recognised within the diatreme. This is similar to some of the kimberlites found in the North West Territories and may allow for a precise age date to be deduced as this indicates that pollen may also have been preserved during intrusion of the diatreme.

Country rock fragments tend to be sub-rounded in shape ie. less angular than for previous intersections. Individual fragments are sometimes rimmed by calcite and fragments themselves have bleached rims indicating that they are out of equilibrium with the matrix magma. Reaction rims suggest that the core is hypabyssal facies kimberlite as per Mitchell's (1986) definitions. The matrix contains a higher percentage of mica, carbonate and has a darker green-black colour that darkens downward. The matrix has a high content of dark green platey material that appears to be chlorite, which may be of the stilpnomelane variety (Fe rich) and the chlorite is aligned along a weak to moderately strong schistosity. The content of mafic xenoliths and macrocrysts is much higher and more varied than for previous intersections. Mafic xenoliths are rounded and generally modest in size being usually less than 3cm in diameter and are quite rare volumetrically within the diatreme. Macrocrysts include dark port-wine coloured garnets 2 to 3 mm in size, olivine, bronzite(?) ortho-pyroxene and rare bright green diopside clino-pyroxene. In general the garnets were found as fragments lining small pits in the outside of the core. It seems likely that the resistant garnets are plucked off of the core during the drilling process and so are much more numerous than have been observed.



Section Facing Az. 175°
BL 150
Ram 6-2
Ram 6-3
--- Road elev = 2028m
Kimberlite
Limey shale + limestone
Kimberlite
gt,cd
br
cd,ov
cd
gt
gt,ov
gt,ov
gt
Calcite veined Kimberlite
k frag
gt,ov
br
coal frag
py,br
ov
cd
ov
Grey dyke
gt,ov
Sheered and bleached Kimberlite
Grey dyke
Limey-graphitic Shale
Dip = -70°
Az. = 265°
E.O.H. = 46.33m
Dip = -45°
Az. = 265°
E.O.H. = 151.49m
0 5 10 15 20 25 30 35
METRES
LEGEND
Roads / Survey line
Ram 5-5
Diamond Drill Hole location
Open fold
Tight fold
Attitude of bedding in hole
Well bedded limy shale and limestone of the Triassic Aged Sulphur Mountain Formation
Kimberlite diatreme
K = Kimberlite dyke
Geological boundary
Minerals of Interest
gt Garnet
cd Chrome diopside
br Bronzite orthopyroxene
ov Olivene or olivene macrocrysts
py Pyrite
Taiga Consultants Ltd.
Skeena Resources Ltd.
ICE PROPERTY
Drill Section DDH Ram 6-2 & 6-3
Location: Elkford
Mining Jurisdiction: Fort Steele
Datum: NAD83
Map Ref.: 082J.006
Scale: 1:500
UTM: 11
Project: 707
Date: Mar.21/2002
Drawn By: REC
Figure: 9

The diatreme material is not homogeneous across its width and there is a transition from east to west from what has been field termed "kimberlite" to "calcite-veined kimberlite" and thence to a sheared and bleached kimberlite. In general core in the upper portion of the kimberlite is very soft and clayey down to 73.30 m where a transition occurs to an almost black coloured rock having 15% calcite veinlets and fracture fillings that is very competent. Calcite veinlets tended to be parallel to the core axis, which likely indicates that they are nearly vertical in orientation. Total calcite content has been estimated to be approximately 20% counting both matrix material and veinlets. Given the carbonate content of the country rock fragments, total percentage of carbonate for the rock as a whole is in excess of 25%.

From 128.0 m to 147.05 m the diatreme is strongly sheared at an angle of 25° to core axis ie. nearly vertical. The rock in this western section is variably bleached, carbonatized, pyritised and for the most part the mica phenocrysts evident in the rest of the core are absent within this section.

The orientation of the contact of the diatreme facies with the shale country rock indicate that the intrusive contact is near vertical. RAM-6-3 was abandoned at 151.49m due to loss of circulation. Given the nature of the target being tested, this is too short to be sure that the diatreme facies does not repeat. It appears that the west margin of the diatreme is in fault contact with the country rock. This is a similar situation to the Cross kimberlite which has a major shear on its east margin.

In cross section (Figure 9) the recent drilling appears to have intersected a single diatreme intrusion root that has an apparent vertical orientation. Additional diatreme material appears to form a thin (approx 20 m) sill-like body extending outward from the main intrusion. Given this explanation it suggests that the previous trenching and sampling was targeted on the sill material and may therefore not have tested the main target. It must be emphasised however that this is not a unique interpretation and that the diatreme may be a sill or dyke-like body that has been folded around a nearly horizontal axis. It is the author's opinion however that the former "in place" explanation is more likely.

A total of 20 thin sections were cut from core samples and were given a cursive microscopic review by the author prior to sending 18 of the sections to Skeena Resources. The thin sections were relayed to Professor McCallum for detailed petrographic and microprobe examination.

The thin sections show that the RAM-6 kimberlite is much more altered than the previously described Bonus diatreme. Most of the olivines have been completely altered to serpentine and the rock in general has been replaced by calcite that makes up most of the groundmass and much of the original textures have been obliterated. It can be seen that olivine originally made up perhaps 20% of the rock in rounded macrocrysts and microphenocrysts. Individual olivine pseudomorphs are outlined by encircling fine-grained opaque minerals in a similar manner to the Bonus diatreme rocks. Orange pleochroic mica phenocrysts and rare sphene(?) are among the few unaltered minerals in the thin sections.

The presence of dark port-wine coloured garnets is very encouraging as a comparison with the examples shown in Schulze (2000) indicate that the colour of garnets intersected in RAM-6-3 is intermediate to those of the G9 and G10 pyrope garnet examples shown. Certainly the presence of these type of garnets, the presence of chrome diopside, olivine and bronzite pyroxenes indicates that the diatreme has likely sampled the types of depths within the lithosphere consistent with the diamond stability field and is therefore prospective for diamonds. The results of the electron microprobe analyses planned for these indicator minerals will be needed to conclusively confirm this conclusion.

RAM-5

The RAM-5 diatreme outcrops in two road cuts (Figure 10, in pocket) separated by a horizontal distance of 130 metres and a vertical distance of 80 metres. Two diamond drill holes (RAM-5-4, RAM-5-5) were completed on the upper road cut. At this site diatreme material is found in two weathered outcrops separated by 38 metres.

Drill hole RAM-5-4 was drilled (Figure 11) to the west into the slope on the most southerly outcrop at an inclination of -45°. The hole intersected greenish grey-brown diatreme mud containing angular fragments of limy shale down to 7.93 m. Within this interval the core is essentially incompetent and only handfuls of mud were collected as a sample. Below this the hole intersected only limy shale and limestone sediments having a near vertical dip. A section of sediment between 36 and 66 m contained at least seven narrow intervals of limonitic-clayey and brecciated zones similar to those seen in hole RAM-6-1 and may represent diatreme material. Not enough features were visible to allow for a definitive identification of diatreme. The hole was drilled to 130.15m and abandoned due to lost circulation.

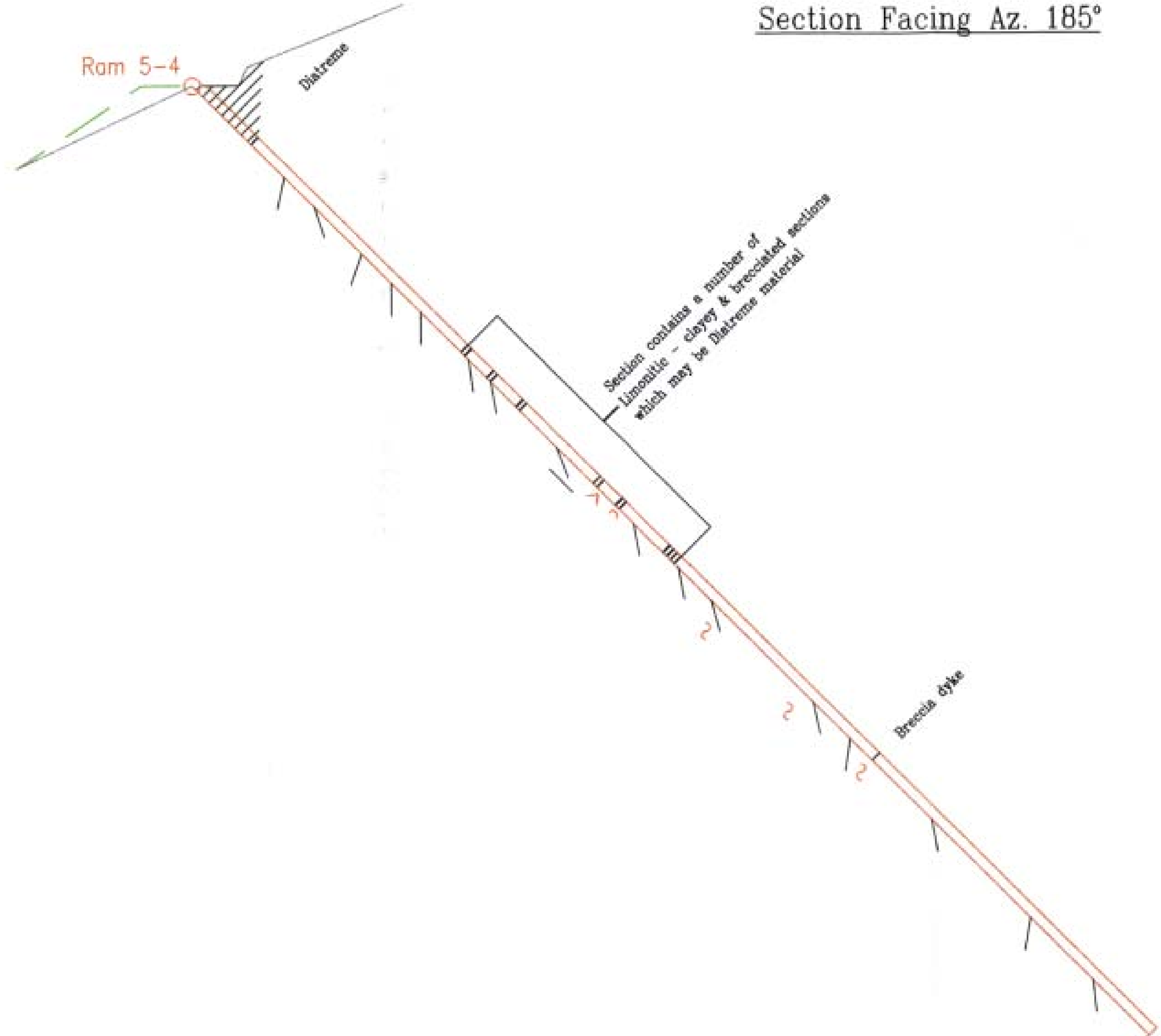
Drill hole RAM-5-5 was drilled at roughly right angles to RAM-5-4 and drilled at –60° (Figure 12). The hole was drilled to a depth of 50.94 m where it was abandoned due to a lack of drill water as the water truck was completely unserviceable. Again the hole encountered sediments with seven intervals of limonitic-clayey and brecciated zones similar to RAM-5-4. The final 0.94 m of the hole were drilled in shale breccia that was identified as diatreme material however the identification is somewhat problematic as core recovery was very low. The breccia returned a weak to moderate calcite response from application of HCL.

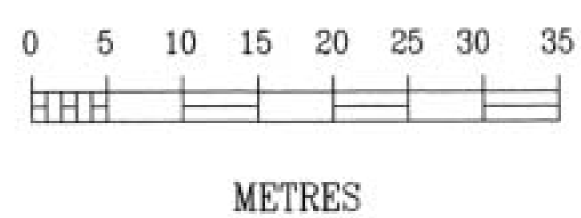
It is likely that the diatreme material seen in outcrop at the drill pads and below in the culvert area are from the same intrusive however it was not possible with the limited drilling carried out to resolve the actual shape of the intrusive body. The RAM-5 diatreme must be considered to remain untested at this time.

Review of M.E. McCallum Petrographic Report

Professor McCallum's recent petrographic examination was written up in an evaluation report and the main points of his analysis are reviewed below. He examined a total of 59 thin sections, 41 of which were from the Bonus pipe and 18 from the RAM-6 pipe. The author also carried on unpublished communications with McCallum in order to discuss more fully the conclusions that could be made from the observations made in his report.

Section Facing Az. 185°





Dip = -45°
Az. = 275°
E.O.H. = 130.15m
Abandoned due to lost circulation

LEGEND

- Roads / Survey line
- Ram 5-5 — Diamond Drill Hole location
- Open fold
- Tight fold
- Attitude of bedding in hole
- Well bedded limy shale and limestone of the Triassic Aged Sulphur Mountain Formation
- Kimberlite diatreme; K = Kimberlite dyke
- Geological boundary

Minerals of Interest

gt	Garnet
cd	Chrome diopside
br	Bronzite orthopyroxene
ov	Olivene or olivene macrocrysts
py	Pyrite

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Drill Section DDH Ram 5-4

Location: Elkford		Mining Jurisdiction: Fort Steele	
Datum: NAD83	Map Ref.: 082J.006	Scale: 1:500	UTM: 11
Project: 707	Date: Mar.22/2002	Drawn By: REC	Figure: 11

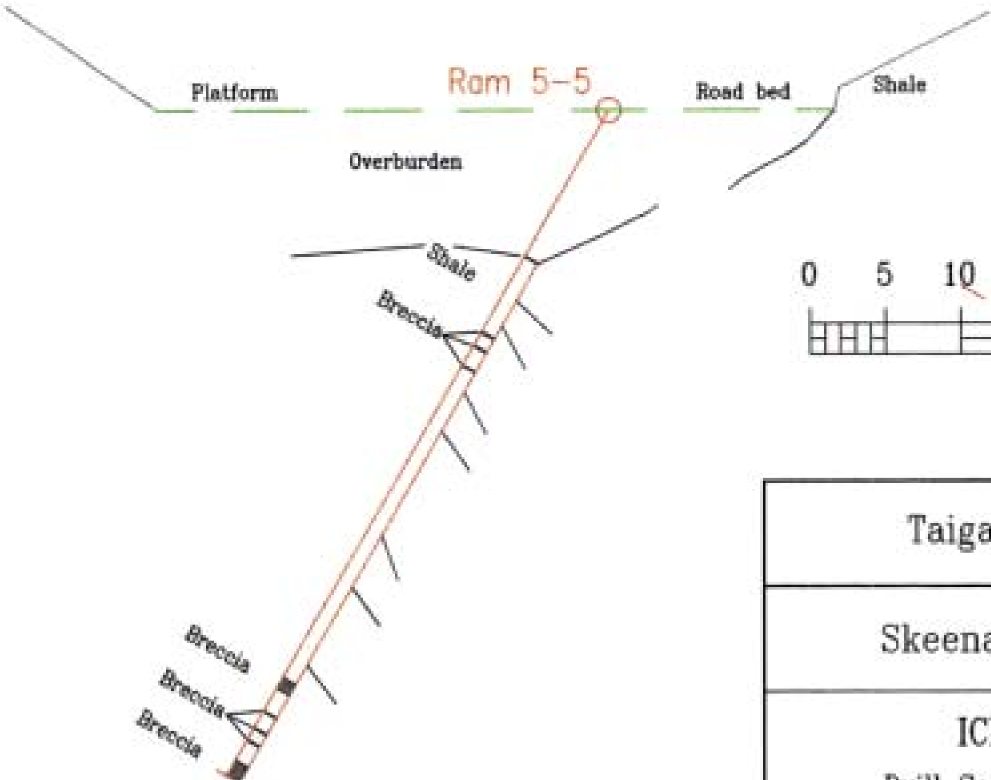
Section Facing Az. 260°

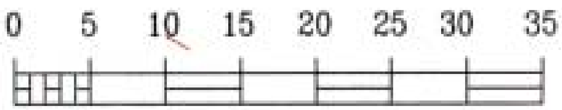
LEGEND

- Roads / Survey line
- Diamond Drill Hole location (Ram 5-5)
- Open fold
- Tight fold
- Attitude of bedding in hole
- Well bedded limy shale and limestone of the Triassic Aged Sulphur Mountain Formation
- Kimberlite diatreme
  K = Kimberlite dyke
- Geological boundary

Minerals of Interest

gt	Garnet
cd	Chrome diopside
br	Bronzite orthopyroxene
ov	Olivene or olivene macrocrysts
py	Pyrite





METRES

Dip = -60°
Az. = 170°
E.O.H. = 50.9m
Abandoned due to lack of water

Taiga Consultants Ltd.

Skeena Resources Ltd.

ICE PROPERTY

Drill Section DDH Ram 5-5

Location: Elkford		Mining Jurisdiction: Fort Steele	
Datum: NAD83	Map Ref.: 082J.006	Scale: 1:500	UTM: 11
Project: 707	Date: Mar.22/2002	Drawn By: REC	Figure: 12

It was McCallum's opinion that the Bonus intrusion was a kimberlite, which would make the Cross and Bonus pipes the only two definitively identified kimberlites in the Elkford area. He also categorised the RAM-6 samples as kimberlite even though they were too altered to provide a definite petrographic identification. He felt that he latter is likely a related kimberlite based on the similarity in textural features and proximal location to the former intrusion and this is a similar conclusion to that previously made in other petrographic work completed on the RAM pipes.

McCallum felt that, while the two kimberlites were somewhat different in appearance, they likely originated from a common source. RAM-6 was described as a diatreme facies kimberlite breccia while he described the Bonus pipe as a hypabyssal facies kimberlite. The latter then represents a much lower stage or root zone of the intrusive while the former represents an upper level subsurface manifestation of a kimberlite pipe. He felt that it was possible that the Bonus could also represent a blind plug or dyke that did not reach the paleo-surface at the time of intrusion.

Both kimberlites contained macrocrysts and microcrysts of serpentinized olivine as well as numerous xenoliths of peridotite and xenocrysts of spinel, ilmenite, clinopyroxene, perovskite and occasionally pyrope garnet. Both intrusion types are characterised by an abundance of autoliths at a variety of scales up to 4 cm. Autoliths are essentially inclusions of related igneous material that have been incorporated into later kimberlitic melts (also can be termed as cognate inclusions). The term autolith seems to cover textural features, which are cored by previous generations of intrusive (the main sense of the word) as well as mantle xenoliths when used in kimberlite terminology. A direct question was put to Prof. McCallum by the author to outline the connection, if any, between diamond prospectivity and the presence of autoliths. His response (April 23/02 e-mail), was that there is no connection between the presence of the two features. It was however, his experience that the Finch Pipe, a prolific diamond producer in South Africa, contained some very fine nucleated autoliths and that the Bonus was similar to samples of other diamond bearing pipes in his possession, that contained autoliths.

Bonus Pipe

The Bonus rocks were termed by McCallum as "variably carbonatized, autolithic (globular segregations or nucleated autoliths common), macrocrystic/microcrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with segregationary texture".

Sub-angular fragments of sedimentary rock and rare heavily altered fragments of diorite(?) and lamprophyre(?) were noted. Peridotite (spinel lherzolite (wehrlite sub-type) and one harzburgite) nodules as cores to autoliths were identified relatively commonly. Spinel and ilmenite grains were identified a microcrysts and rare macrocrysts. Spinels are usually rimmed by titanomagnetite, perovskite, rutile, anatase, kassite and titanite (sphene). Spinel from thin section #20 was identified as coming from "the upper mantle" by the fact that the species was pale brown in colour and not opaque like the Cr rich lower mantle species.

Autoliths were classified into four rock types:

1) "weakly carbonatized, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral rich, calcite serpentine kimberlite"
2) "weakly carbonatized, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral rich, calcite serpentine kimberlite with local segregationary texture"
3) "weakly carbonatized, macrocrystic, hypabyssal, perovskite/opaque mineral-rich, calcite phlogopite serpentine kimberlite with minor segregationary texture"
4) "extensively carbonatized, weakly macrocrystic strongly microcrystic, hypabyssal, perovskite, opaque mineral and phlogopite-bearing, serpentine kimberlite, with minor segregationary texture

Additional subtypes or variants exist for all four categories of autolith. Age relationships were established for autolith types from oldest to youngest as:

Type 3 > Type 4 > Type 2 > Type 1

McCallum concluded that the Bonus kimberlite pipe with high concentrations of autoliths and low concentrations of wall-rock sediments "is more likely to have a higher diamond grade than tested portions of the RAM-6 pipe".

RAM-6 Pipe

The RAM-6 samples were classified as "weakly to moderately foliated, variably carbonatized, silicified serpentinized olivine macrocryst/microcryst/fragment-rich, diatreme facies kimberlite heterolithic breccia, with abundant altered sedimentary wallrock clasts, autoliths and pelletal lapilli".

Autoliths similar in appearance to Type 3,3A, and 4 of the Bonus pipe were noted in RAM-6 thin sections. Sedimentary rock fragments made up between one third and half of the rock volume. Garnets were noted in five instances with at least one having a kelyphitic rim.

Prof. McCallum felt that the presence of "foliation" inferred a "significant component of flow during emplacement of the kimberlite breccia". The significance of this was not explained.

It was Prof McCallum's opinion (April 24,02 E-mail) that the current status of the project on the Ice property was that "considerable promising results" had been obtained and that the company "has literally scratched the surface". He felt that the critical goal to accomplish in future is to locate additional pipes for testing and that "more work" needs "to be done in the area".

Bonus Kimberlite Mini-Bulk Sample Processing

The mini-bulk sample collected from the trench blasted in the Bonus kimberlite was sent to the Ashton Mining of Canada Inc. laboratory in North Vancouver for dense media separation processing and macro-diamond recovery. The sample was delivered to the laboratory on January 11, 2002 once a contract was signed and a processing date scheduled. Ashton weighted the material and found that it had a net weight of 3827 kilograms. Due to its large size the sample was broken up into three 1300 kilogram sub-samples and treated according to the following flow sheet:

1) Crushing to 2 mm
2) Run through a 100 mm cyclone to effect a density separation in the +0.5-6.0 mm size range
3) Run through a dense media separation plant (DMS) with a 2.75 g/ml slurry density.
4) Removes all material above 3.00 g/ml (diamond density = 3.52 g/ml)
5) Concentrates dried and screened at 0.8, 1.0, 2.0, 4.0 mm
6) Three smaller sized concentrates treated to a series of heavy liquid separations to +3.32 g/ml to produce a final concentrate
7) Hand sorting using microscope
8) Hand picking of any diamonds contained

The process is designed to separate all diamonds in the +0.5 to 6 mm size range, i.e., macro-diamonds. No diamonds were recovered in the any of the three sub-samples that make up the mini bulk sample.

In typical kimberlite testing programs the results of a sample test are used to justify going to the next step where successively larger sample sizes are taken to better understand the diamond content, diamond size and diamond quality distribution with the kimberlite being tested. In a comparable test such as that of the Slaon 1 & 2 kimberlite complex in Colorado a bulk sample of 50 tonnes each was collected from "numerous" test pits (Otter et al 1991) to give an indication of overall diamond content. The adjacent Kelsey 1 kimberlite was tested using a 500 tonne sample size (Coopersmith 1993). Clearly a large test sample size is required to definitively test the diamond content of an individual kimberlite body.

Considering that he Sloan 1 and Kelsey 1 kimberlites have rough dimensions of 100 X 600 m and so are considerably larger than the Bonus kimberlite. It would be reasonable to assume that the small roughly four tonne sample would be more statistically reliable for the Bonus kimberlite than for a larger body. In the case of the Bonus kimberlite the results were disappointing such that the author takes this result to indicate that a larger test sample is not merited.

RAM-6 Drill Core Sample Treatment

A total of 218.9 kg of drill core sample from the RAM-6 kimberlite was delivered to the Kennecott Exploration Canada laboratory in Thunder Bay, Ontario on January 18,2002 for caustic dissolution treatment. The sample was crushed to 10 mm and then split to 10 kg charges and then treated to NaOH fusion at 550° C. At the end of this process the residue was collected, acid leached and then the ferromagnetic minerals were removed and classified and then microscopically examined for diamonds. Kennecott reports (e-mail Simon Griffiths, ----2002) that the treatment did not return any macrodiamonds from the sample. Final report for the treatment has not been received and is pending and so only preliminary results are included in the present report.

R.C

CONCLUSIONS AND RECOMMENDATIONS

The 2001 exploration program consisted of geologic mapping of the RAM-6 diatreme was successful in the diamond drill core sampling of the RAM-6 diatreme. The intrusive breccia was identified as having the geometric shape of a vertically plunging stock with a minimum diameter of 80 metres with radiating sill-like apophyses roughly 17 m thick. A number of port wine coloured garnets were observed in the core that had a colour consistent with G9 garnets from kimberlites derived from the diamond stability field in other parts of the world. The 218.9 kg core sample from the RAM-6 diatreme was caustically treated to extract diamonds in the +0.5 mm range. The sample treatment did not return any diamonds in the size range tested. While the sample size taken must be considered too small to be considered a definitive test, the microdiamond grade of the diatreme must be considered to be very low and so additional, larger scale test sampling is not merited.

The diamond drilling on the RAM-5 diatreme was hampered by the presence of broken ground and in the lack of available drill water such that the drilling could not be completed as planned. What little drilling that was completed did not allow for a resolution of the geometric shape of the diatreme. The drilling did encounter a number of narrow brecciated "gouge" zones, which had the appearance of marginal phases of the diatreme body however a positive identification of either kimberlite or diatreme could not be made. There was insufficient sample available to allow for either testing for diamonds or diamond indicator minerals. For all intents and purposes the RAM-5 target remains un-tested.

The Bonus kimberlite was geologically mapped, mini-bulk sampled by blasting and trenching producing a 3827 kg sample which was treated to separate any diamonds in the +0.5-6.0mm size range. The Dense Medium Separation treatment did not return any diamonds in the size range tested. The diamond grade of the Bonus kimberlite must be assumed to be too low to be of economic interest.

The RAM-6 and RAM-5 diatremes were test surveyed along the road using a sensitive magnetometer and found to have a magnetic response indistinguishable from the surrounding sedimentary bedrock.

Samples of the Bonus kimberlite and RAM-6 diatreme collected for thin section and then petrographically analysed by a noted kimberlite authority. It was found that the Bonus kimberlite was identified as a true kimberlite making it the second only kimberlite conclusively identified in British Columbia. The Bonus was assigned the name "variably carbonatized, autolithic (globular segregations or nucleated autoliths common), macrocrystic/microcrystic, hypabyssal, perovskite and phlogopite bearing, opaque mineral rich, calcite serpentine kimberlite with segregationary texture".

The Bonus was found to be multiphase and rich in autoliths cored by spinel lherzolite and harzburgite nodules derived from the mantle. In one case the spinels in these nodules were identified as a chrome poor variety derived from "the upper mantle".

The RAM-6 diatreme was found to be too altered to provide a definitive petrographic identification of kimberlite however given its textural similarity to the Bonus kimberlite and its close proximal

Rl.

position to that body it was concluded to be a related intrusion to the Bonus pipe. The RAM-6 diatreme was identified as "weakly to moderately foliated, variably carbonatized, silicified serpentinized olivine macrocryst/microcryst/fragment-rich, diatreme facies kimberlite heterolithic breccia, with abundant altered sedimentary wallrock clasts, autoliths and pelletal lapilli".

In consultation with Professor M.E. McCallum it was concluded that while individual kimberlites tested to date were found not to be of economic interest, the validity of the Ice Diamond project as a whole has not yet been tested. The fact that there are a number of different types of kimberlites within the property forming a kimberlite field and that individual kimberlites are multi-phase indicates that there is potential to find other kimberlites with different compositions and intrusion histories than those found to date. There exist on the property as yet untested geochemical anomalies relating to the year 1999 sampling program. This indicates that there remains a significant potential to find other kimberlites on the property that may have sampled more favourable portions of the mantle within the diamond stability field and that could potentially have economic diamond potential. With this conclusion in mind it is recommended that additional exploration be carried out away from the currently known kimberlites.

Exploration should take the form of detailed stream sediment and soil sampling in the vicinity of previously identified targets in order to identify targets meriting diamond drill testing. Dependent upon the success of this Phase one program a diamond drill program would be completed to test he targets generated. The expected cost of these programs would be $175,000 and $200,000 respectively.

PROPOSED EXPLORATION BUDGET

Follow-up soil sampling and heavy mineral processing to kimberlite indicator mineral anomalies defined during the 1999 sampling program. Included would be prospecting, geologic mapping and ground magnetic surveys on any area of interest.

Phase 1		
Geologist – geologic mapping	25 days @ $500/day	$ 12,500
Field samplers	3 x 25 days @ $400/day	30,000
Helicopter for crew movement & sample collection		
	30 hours @ $950/hr	28,500
Trucking samples		2,000
Transportation	2 trucks x 25 days @ $75/day	3,750
Hotel/board	4 men x 25 days @ $100/day	10,000
Sample analysis		
Process and separation	100 samples @ $200/sample	20,000
Picking	100 samples @ $60/sample	6,000
Grain analysis	100 samples @ $200/sample	20,000
Geochemist report		5,000
Field supplies		5,000
Rentals (geophysical equipment, road construction etc)		5,000
Report		
Geologist	15 days @ $500/day	7,500
Drafting & Repro		3,500
Miscellaneous		1,000
Management Fee		15,250
TOTAL		175,000
Phase 2 Diamond Drilling		200,000
GRAND TOTAL		$375,000

CERTIFICATE – Robin E. Chisholm

I, Robin E. Chisholm, of 15 Roseview Drive NW in the City of Calgary in the Province of Alberta, do hereby certify that:

1 I am a Consulting Geologist with the firm of Taiga Consultants Ltd. with offices at Suite 301, 1000 - 8th Avenue SW, Calgary, Alberta.

2. I am a graduate of Carleton University, B.Sc. (Hons.) Geology (1977), and I have practised my profession continuously since graduation.

3. I am a member in good standing of the Association of Professional Engineers, Geologists and Geophysicists of Alberta; and I am a Fellow of the Geological Association of Canada.

4. I am the author of the report entitled "Evaluation of the Ice Diamond Exploration Property and the Results of the Diamond Drilling and Bulk Sampling of the RAM-5, Ram-6 and Bonus Kimerlite Targets, dated May 01, 2002. I have visited the property mentioned in the report and supervised the recent field program.

5. I own no shareholding in Skeena Resources Limited and do not expect to receive any interest (direct, indirect, or contingent) in the property described herein nor in the securities of or any related companies in respect of services rendered in the preparation of this report.

6. I hereby give my permission for the use of this report in a prospectus, in its complete and unedited form. Written permission of the author is required before publication of any excerpt or summary.

DATED at Calgary, Alberta, this 29 day of May, A.D. 2002.

Respectfully submitted,

PROFESSIONAL GEOLOGIST ROBIN E. CHISHOLM ALBERTA

Robin E. Chisholm, B.Sc., P.Geol., F.GAC

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APPENDIX

Summary of Personnel

Summary of Expenditures

Diamond drill logs RAM-6-1 to 3, RAM-5-4, RAM-5-5

2002 McCallum Petrographic Report

2002 Ashton DMS Report

2002 Kennecott caustic fusion analyses of drill core – preliminary results

Summary of Personnel

Taiga Consultants Ltd			
Robin Chisholm, P.Geol	Field	Sept 2-26 2001	25 days
	Reclamation	Sept 29- 30 2001	2 days
	Report & sample handling		15 days
Skeena Resources Limited			
Rupert Allan, P.Geol	Field	Aug 6 - Oct 29 2001	13 days
	Office	Aug 6 – Oct 29 2001	4.5 days

LeClerc Drilling

Jean-Guy Leclerc	Manager/ tanker driver
Shirley LeClerc	Office Manager
Scottie Hatlo	Driller
Mike LeClerc	Drill assistant
Garry Beaupre	Drill Assistant

SuperGroup Holdings

Brian Collirson	transport & core handling	Sept 22 –23 2001	2 days

ICE PROPERTY, B.C. Assessment Expenditures July 1, 2001 – May 31, 2002

1) Diamond Analyses			
Dec. 01/01	Ashton Mining mini-bulk sample, DMS plant	$21,500.00	
Feb. 28/02	Kennecott (R. Chisholm) – core	236.25	
Mar. 04/02	Kennecott – core, caustic fusion	15,393.00	37,129.25
2) Petrographic Analysis			
May 20/02	M. MacCallum $5000 USD @ 1.528		
	7,640.00		7,640.00
3) Core Drilling			
Sept 21/01	Leclerc Drilling, Cranbrook	35,968.00	
Sept 30/01	Leclerc	17,466.64	53,434.64
4) Trenching			
Sept 28/01	Minconsult		2,775.25
5) Travel, Helicopter Transportation, Freight, Camp			
Sept 30/01	Super Group Holdings	925.00	
Sept 30/01	Super Group	188.50	
Sept 21/01	J.R. Allan, expense rept.	177.32	
Oct 31/01	Taiga Consultants Ltd.	26.12	
Oct 31/01	Taiga Consultants Ltd.	21.22	
Dec 31/01	J. R. Allan, expense rept.	12.50	
Sept 30/01	McNair Enterprises, Elkford	120.00	
Sept 21/01	J.R.Allan, expense rept.	5,674.31	
Sept 30/01	Super Group	960.00	
Sept 30/01	Dolfo Transport	654.73	
Oct 29/01	Bighorn Helicopters	6,049.00	
Dec 31/01	Taiga Consultants Ltd.	19.42	
Dec 31/01	High Standard	383.00	
Mar 06/06	Dolfo Transport	797.30	
Mar 04/02	Taiga Consultants Ltd.	181.35	16,189.77
5) Geological Mapping, Supervision; Geophysics			
Oct 29/01	Cold Stream Exploration Ltd.	8,750.00	
Oct. 29/01	Taiga Consultants Ltd.	16,907.23	
May 30/02	Taiga Consultants Ltd.	1,791.72	27,448.95
6) Road Rehabilitation and Reclamation			
Sept 29/01	*Ter Contracting – back-hoe*	2,198.37	
Dec 30/01	Taiga Consultants Ltd.	2,076.08	4,274.45
7) Maps, Drafting, Reproductions			
Oct. 31/01	Taiga Consultants Ltd.	2,022.56	
Oct. 31/01	Taiga Consultants Ltd.	1,736.15	
Oct. 31/01	Taiga Consultants Ltd.	51.80	3,810.51
	TOTAL		**$ 152,702.82**

TAIGA CONSULTANTS LTD.
Calgary, Alberta

DIAMOND DRILL LOG

CLIENT:	SKEENA RESOURCES LIMITED
PROJECT:	ICE PROPERTY

Area ELKFORD B.C.	Latitude 50° 05' . 498"	Bearing VERTICAL	Date Started SEPT 03/01 11:00 AM
Contractor LECLERC DRLG.	Departure 114° 57' . 940'	Inclination @ collar ____	Date Completed SEPT 04/01 4:00 pm
Core Size 4.8 cm	Elevation GPS 2031 m ≅ 6665'	Inclination @ ____ m, ____ / Inclination @ ____ m, ____	Total Length 48.46 m (159')
Hole No. RAM-6-01	Logged by R. CHISHOLM	Sheet 1 of 3	

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION	% REC.	SAMPLE NO.	FROM	TO	LENGTH	ANALYSES		
0	2.13	2.13	NO RECOVERY, CASING	0							
2.13	2.48	0.35	KIMBERLITE (?), DK ORANGE-BRN, MASSIVE, BRECCIA FRAGMENTS ANGULAR, POORLY SORTED, MAINLY DK BRN MUDSTONE, NO FIZZ IN HCL FOR MATRIX & FRAGS, LIMONITE B/C OF WEATHERING, CORE VERY SOFT,	100							
2.48	8.90	6.42 m	KIMBERLITE, PALE YELLOW GREEN, MASSIVE, BRECCIA, NON-MAG. FRAGMENTS UP TO 8 cm BUT MOSTLY < 1 cm, — FRAG. COMPOSITION SILTY GY LMST, MUDSTONE?, DK GY FINE-GRND SED, COALY MUDSTONE, FINE PARTICLES OF SHINY BLACK COAL, 3% RUSTY ORG-RD SPOTS ⇒ ORTHOPYX?, FRAGS ANG-MOD ROUNDED, FRAG % ≈ 30 — MATRIX VARIABLY WEAKLY CALCAREOUS, MICACEOUS < 5% PALE YELLOW-GRN, CLAYEY. 3.66 - 4.90 FINE-GRD, PALE YW-GRN ALT ZONE								
			2.44 - 3.66 / 1.22 / LOST 38 cm	69							
			3.66 - 5.18 / 1.52 / 75 cm	49							
			5.18 - 8.23 / 3.05 / 63 cm	79							
			8.23 - 8.33 / .10 / 10 cm	0							
			8.33 - 9.45 / 1.12 / —	100							
			CONTACT SHARP 62° TCA								

DIAMOND DRILL LOG

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION	% REC.	SAMPLE NO.	FROM	TO	LENGTH	ANALYSES			
8.90	48.50		MIXED SHALE & LIMSTONE, WELL BEDDED, THINLY LAMINATED, DK GY-BRN LIMEY SHALE WITH 15% LT GY LIMESTONE, INCREASINGLY KRACKLED DOWNWARDS WITH WHT CALCITE FILLING									

BEDDING	RECOVERY FROM-TO	INT.	LOST	% REC.	
9.00 m 18°. TCA					
13.50 24°					
16.70 25°	9.45 - 21.60	12.15	–	100	
18.00 25°	- 22.86	1.26	.80	37	
20.80 FOLD NOSE, OPEN, AXIS ⊥ TCA	23.62	0.76	.29	64	
	24.99	1.33	1.32	01	
21.80 CORE GROUND	28.04	3.05	2.84	07	
23.62 - 28.04 V. LOW CORE RECOVERY	29.57	1.53	0.79	75	
WASHED AWAY	31.09	1.52	0.35	77	
25.60 - 34 m STRONGLY KRACKLED &	32.61	1.52	0.10	93	
BRECCIATED WITH DIFFUSE	34.14	1.53	–	100	
INVASION OF FINE-GRD,	35.36	1.22	–	100	
GRN-YW-ORG. KIMBERLITE (?)	35.81	0.45	–	100	
HOLE FOLLOWING EDGE OF	37.03	1.22	–	100	
INTRUSIVE ?	38.56	1.53	.50		? NO CORE LOSS
	40.23	1.67	–	100	
35.56 45°	40.84	0.61	–	100	
36.25 60°	43.28	2.44	+.10	+100	
37.90 FOLD NOSE, AXIS ⊥ TCA	44.81	1.53	+.27	+	
41.25 " " "	45.72	0.91	+.10	+	
43.20 " " "	47.24	1.52	.69		
47.40 - 47.65 SERIES OF 4 FOLD NOSE ⊥ TCA	48.31	1.07	46		

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DIAMOND DRILL LOG

PROJECT NO. 2291
HOLE NO. RAM-6-01 Page 3 of 3

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION	% REC.	SAMPLE NO.	FROM	TO	LENGTH	ANALYSES			
			44.10 85° TCA									
			43.75 – 44.10 BRECCIATED & INVADED BY RUSTY INTRUSIVE									
			45.00 45° TCA									
			45.50 80° TCA									
			46.10 – 47.24 CORE BROKEN, 0.69 m LOST (?)									
			47.25 // TO CORE AXIS, FOLD NOSE									
			47.50 85° TCA									
			EOH 48.50 m									
			METERAGE OFF BY 0.30 cm IN LAST RUN									

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DIAMOND DRILL LOG

CLIENT:
PROJECT:

Area ELKFORD, B.C.	Latitude	Bearing 265°	Date Started SEPT 06/01, 7:00 AM	Hole No. RAM-6-02
Contractor LeCLERC DRILLING	Departure	Inclination @ collar ______ Inclination @ ______ m, ______	Date Completed SEPT 06/01, 5:00 pm	Logged by R. CHISHOLM
Core Size 4.8 cm	Elevation 2031 m − 6.5 m = 2024.5	Inclination @ ______ m, ______	Total Length 46.33	Sheet 1 of 3

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION	% REC.	SAMPLE NO.	FROM	TO	LENGTH	ANALYSES			
0	3.50	3.50	NO RECOVERY, CASING									
3.50	17.95	14.45	KIMBERLITE, V. DK GY-GRN WITH BLACK SECTIONS, MOD FIZZ IN HCL, RARELY WEAKLY MAGNETIC - MASSIVE, BRECCIA WITH FRAGS. TO 5 cm BUT USUALLY < 1 cm, FRAGS ANGULAR BUT MANY SUB-ROUNDED, CORE IS SOFT BUT COMPETENT									
			FRAGMENTS LIMEY SHALE, COAL + COALY SHALE, LMST. BROWN MUDSTONE, RED-ORANGE LIMONITE FRAGS ⇒ OPX MACROCRYST									
			FRAGS % 30% BY VOLUME									
			MATRIX = CALCITE + BIOTITE + IRON OXIDE (LIMONITE) + CLAY?									
			13.28 - 13.80 - PALE YW-GRN SECTION ALTERED TO CLAY TR. CALCITE									
			17.74 - 17.90 LIMEY SHALE FRAG. BEDDING 50° TCA									

RECOVERY

FROM - TO	INT	LOST	%
3.66 - 5.18	1.52	0.63	59
5.18 - 6.70	1.52	0.63	59
6.70 - 8.23	1.53	+.10	100
8.23 - 9.75	1.52	—	100
9.75 - 11.28	1.53	0.18	88
11.28 - 12.19	0.91	0.69	74

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DIAMOND DRILL LOG

PROJECT NO. Ice Property
HOLE NO. RAM-6-02 Page 2 of 3

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION		Recovery From - To	Int	Lost	% REC.	SAMPLE NO.	FROM	TO	LENGTH	ANALYSES			
17.95	46.33	28.38	LIMEY SHALE, WELL BEDDED & LAMINATED WITH Lt Gy LIMESTONE BEDS & LAMS.													
			18.75 m	FOLD NOSE, BED // TCA												
			19.06	KRACKLE WITH CALCITE FILL												
			20.00	BED 45 TCA												
			21.00	CALCITE VEIN 1.5 cm // TCA												
			21.20	BED 43° TCA												
			22	FOLD NOSE, BROAD, ⊥ TCA												
			22.50	BED 32° TCA												
			23.20	MINOR KINK IN BED												
			24.20	FOLD NOSE AXIS ⊥ TCA, BROAD												
			24.60	BED 25° TCA	12.19 - 12.80	0.61	—	100								
			26.00	BED 90° TCA	12.80 - 14.33	1.53	—	100								
			26.52	1.5 cm CALCITE VEIN // TO BED + KRACKLE	14.33 - 15.85	1.52	0.23	85								
					15.85 - 17.38	1.53	0.35	77								
			27.50	BED 28° TCA	17.38 - 18.59	1.21	0.15	88								
			29.00	BED 80° TCA	18.59 - 20.12	1.53	—	100								
			30.35	20 cm CALCITE VEIN 25° TCA	20.12 - 20.73	0.61	—	100								
			31.30	FOLD NOSE ⊥ TO CORE AXIS	20.73 - 21.95	1.22	—	100								
			31.80	BED 80° TCA	22.86	0.91	—	100								
			32.00	FOLD NOSE	24.38	1.52	—	100								
			32.50	BED 30 TCA	25.00	0.62	—	100								
			33.10	FOLD NOSE, SHARP, 75° TCA	26.52	1.52	—	100								
			33.80	FOLD NOSE, BROKEN	27.28	0.76	0.30	61								
			34.50	BED 45° TCA	28.80	1.52	—	100								
			35.01	1.5 cm CALCITE VEIN 15° TCA	29.72	0.92	—	100								
			35.50	FOLD NOSE, SHARP, 80° TCA	30.63	0.91	—	100								

DIAMOND DRILL LOG

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION	Recovery From - To	Int.	Lost	% REC.	SAMPLE NO.	FROM	TO	LENGTH	ANALYSES			
			36.25 BCO 30° TCA												
			37.75 SERIES OF 3 FOLD NOSE AT 80° TCA CUT OFF BY												
			REHEALED SHEAR 40° TCA												
			38.00 BCO 30°												
			39.50 FOLD NOSE BROAD, ⊥ TCA												
			40.50 FOLD NOSE TIGHT, ⊥ TCA	30.63 - 32.16	1.53	–	100								
			41.10 FOLD NOSE " "	- 33.68	1.52	–	100								
			41.85 - 43.37 AMORPHOUS LMST	- 35.36	1.68	–	100								
			- BAND FOLD NOSE?	- 36.88	1.51	–	100								
			42.50 FOLD NOSE	- 37.50	0.62	–	100								
			42.40 → VERY BROKEN CORE	- 38.70	1.20	–	100								
			42.75 BCO 80° TCA	- 40.23	1.53	–	100								
			43.90 FOLD NOSE	- 41.75	1.52	–	100								
			46.00 FOLD NOSE, MINOR KINK FOLD	- 42.37	0.62	–	100								
				42.37 - 43.90	1.53	0.40	74								
				- 44.50	0.60	0.15	75								
				- 45.11	0.61	0.20	67								
				- 45.42	0.31	0.15	52								
				- 46.33	0.91	0.40	56								
			46.33 EOH												

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DIAMOND DRILL LOG

CLIENT:	SKEENA RESOURCES LIMITED
PROJECT:	ICE PROPERTY

Area ELKFORD, B.C.	Latitude	Bearing 265°	Date Started SEPT 7/01, 7.00 AM	Hole No. RAM-6-03
Contractor LECLERC DRILLING	Departure	Inclination @ collar -45	Date Completed SEPT 13/01, 10.00 AM	Logged by R. CHISHOLM
Core Size NQ	Elevation 2031 - 6.5 = 2024.50 m	Inclination @ ____ m, ____ / Inclination @ ____ m, ____	Total Length 151.49	Sheet 1 of 11

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION	% REC.	SAMPLE NO.	FROM	TO	LENGTH	ANALYSES			
0	3.66	3.66	CASING - RECOVERED ≈ 0.50 m OF NQ CORE YW-GRN, SOFT KIMBERLITE (?) WITH 5% LIMONITE BLEBS TO 0.5 cm, STRONG HCL FIZZ ⇒ CALCITE - MUCH SLOUGH SHALE - TWO LARGE COBBLES/FRAGS OF PURPLE PORPHYRITIC LAMPROPHYRE, 5% MAFIC MIN TO 4 mm, STRONG HCL FIZZ ⇒ CALCITE STRONG SULPHUR SMELL WHEN CRACKED									
3.66	24.50	20.84	KIMBERLITE, MED-GRN-BRN AT TOP DARKENING TO GREENISH BLACK BY 19.00 m, LIGHTER COLOURED VARIES FROM SOFT TO CRUMBLY TO COMPETENT AT 19 m, VARIABLE FIZZ IN HCL BUT MOD-STRONG - FIRST 19 m VERY MUDDY/CLAYEY MUST BE SCRAPED BY HAND, FEATURES NOT VERY VISIBLE - MATRIX CONSISTS OF 10% CALCITE, 15% BRONZY BIOTITE TR - 2% LIMONITE BLEBS TO 5 mm, NON-MAG, - CONTACT 50° TCA SHARP - FRAGMENTS HIGHLY VARIABLE 20 - 50 % CORE VOLUME 15 cm MAX SIZE, FEW FRAGS > 2 cm, 95% < 1 cm FRAGS LIMEY SHALE, COAL, CHST, MUDSTONE SHAPE ANGULAR - ROUNDED,									

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DIAMOND DRILL LOG

PROJECT NO. Ice Property
HOLE NO. RAM 6-03 Page 2 of

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION	% REC.	SAMPLE NO.	FROM	TO	LENGTH	ANALYSES		
			13 to 14m gradual change to light ylw-grn-gy								
			+ abundant white calcite veinlets								
			14.90 – 15.10 large olive grn mudstone frag.								
			15 to 18.50 very crumbly, core dissolved								
			23.50 – 24.50 contact zone								
			c lighter coloured, mi competent, abundant coarse shale frag								
			24.20 & 24.70 two large 1cm & 2cm, macrocrysts slightly rusty, rimmed by calcite, rounded olivine/opx?								
			24.50 contact with shale very sharp 50° TCA								

Recovery

FROM - TO	INT	LOST	% REC.	SAMPLE NO.	FROM	TO	LENGTH
3.66 – 5.18	1.52	1.23	19				
6.40	1.22	0.55	55				
7.92	1.52	–	100				
9.45	1.53	0.25	84				
10.67	1.22	0.72	41				
12.19	1.52	0.32	79				
13.11	0.92	0.51	45				
14.02	0.91	0.17	81				
15.24	1.22	[illegible]	100	N6	core	lan	+ .10
16.00	0.76	–	100				- .16
17.53	1.53	–	100				
18.29	0.76	–	100				
19.81	1.52	.06	96				
21.34	1.53	–	100				
22.86	1.52	–	100				
23.77	0.91	0.17	81				
24.69	0.92	0.10	89				

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DIAMOND DRILL LOG

PROJECT NO. ______
HOLE NO. RAM 6-3 Page 3 of ____

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION	RECOVERY FROM - TO	INT	LOST	% REC.	SAMPLE NO.	FROM	TO	LENGTH	ANALYSES
24.56	25.18	0.68	LIMEY SHALE, INCOHERENT FOLDING & FRACTURING									
			BED // TCA,									
			LOWER CONTACT IRREGULAR BUT KNIFE SHARP									
25.18	25.45	0.27	KIMBERLITE, GREENISH GY,									
			FRAGS TO 3 cm, SHALE,	RECOVERY								
			STRONG FIZZ IN HCL	FROM - TO	INT	LOST						
			N.B. 5 ROUNDED MACROCRYSTS	24.69-26.21	1.52	—	100					
			RUSTY WEATHERING	27.75	1.53	—	100					
				29.26	1.52	—	100					
			LOWER CONTACT 23° TCA, SHARP	30.78	1.52	—	100					
				32.30	1.52	—	100					
25.45	27.95	2.50	LIMEY SHALE, KRACKLED & FILLED	33.68	1.38	—	100					
			WITH CALCITE	35.35	1.67	—	100					
			BED WAVY OVER 50 cm BUT	36.88	1.53	—	100					
			// TCA	38.25	1.37	0.35	74					
			LOWER CONTACT OBSCURE	38.70	0.45	0.05	89					
			WEDGE OF FINE-GRD KIMBERLITE	39.62		0.08						
			AT 27.85 m	41.15		0.20						
				42.37		0.10						
27.95	28.15	0.20	KIMBERLITE, FINE-GRD, PURPLE-GY	42.98		0.07						
			MOD. FIZZ HCL	44.20		0.10						
				44.65		—	100					
			LOWER CONTACT 45°, SHARP	45.26		0.14						
28.15	41.82		GREY SHALE WITH LMST. LAMS,									
			GENERALLY KRACKLED & CALCITE									
			FILLED, BEDDING BROADLY									
			WAVY & // TCA									

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DIAMOND DRILL LOG

PROJECT NO. ______
HOLE NO. ______

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION	% REC.	SAMPLE NO.	FROM	TO	LENGTH	ANALYSES			
			31.00 BED // TCA									
			32.30 BED									
			32.80 FOLD NOSE, OPEN AXIS ⊥ TCA									
			33.70 BED 75° TCA									
			39.75 BED 80° TCA									
			41.15 - 41.82 BEDDING DIFFUSE BUT MAINLY SUB-// TO CORE AXIS, STRONGLY DISRUPTED									
			- CONTACT WITH KIMBERLITE 15° TCA VERY SHARP									
41.82	113.40	71.58	KIMBERLITE, DARK GY-BLK, VERY SOFT, MUSHY WITH HARDER SECTIONS, CALCAREOUS MED FIZZ HCL									
			FRAGS > 40%, MAX SIZE 10 cm, 90% < 2 cm, SUB-ROUNDED, BLEACHED RIMS ⇒ DISEQUILIBRIUM									
			WHT CALCAREOUS FRACTURES // TO CORE, WEAK SCHISTOSITY 20°-30° TCA, FRAGS // TO SCHIST., CALCITE RIMS TO MUDSTONE									
			- UPPER CONTACT SHARP, ZONED, ½ cm MASSIVE BIO. 15 cm. OF 80% DOLOMITE(?) WHITE IN FRACTURE NETWORK									
			FIRST 3 m VERY LITTLE REACTION TO HCL									
			- FRAGS LIMEY-SHALE > MUDSTONE(?) > COAL > QTZITE ? RARE PYRITE CHUNKS UP TO 1cm									
			- MATRIX VARIABLE BUT BRONZY BIO UP TO 3 mm, ≈ 20%, BLK CHLORITE (?) ≈ 40%, CALCITE 10% CLAY 30% (?)									
			COLOURS DARKEN DOWNWARDS AS CORE BECOMES MORE COMPETENT									

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DIAMOND DRILL LOG

PROJECT NO. ______
HOLE NO. ______ Page 5 of ____

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION				% REC.	SAMPLE NO.	FROM	TO	LENGTH	ANALYSES		
			- 58.20 2 mm GARNET, WINE RED PYROPE											
			- 58.25 MACROCRYST (?) 1.5 cm, ROUND, PALE YW-GRN											
			- 58.38 SAA											
			- 58.40 2 mm, CRYSTAL, MED GRN -, SQUARE HABIT											
			CR-DIOPSIDE?											
			- 59.30 8 mm, ROUND, BRONZY PYROXENE?											
			MACROCRYST	RECOVERY										
				FROM - TO	INT.	LOST								
			- 60.45 1.5 cm PYRITE FRAG	45.26 - 46.03	0.77	0.11	86							
			ANG, SLIGHTLY RUSTY	47.24	1.21	0.26	79							
			- 61.50 FAINT SCHIST 15° TCA	48.16	0.92	0.50	46							
			- 65.00 1 cm PYRITE FRAG	48.92	0.76	0.53	30							
			ANGULAR, FRESH	49.53	0.61	—	100							
			- 65.00 CALCITE VEINLETS AT	51.05	1.52	—	100							
			40° TCA	51.97	0.92	—	100							
			- 67.27 1 mm CR-DIOPSIDE, BRIGHT	53.34	1.37	—	100							
			GRN.	53.95	0.61	0.20	67							
			- 67.55 - .80 MANY SMALL ROUNDED	55.02	1.07	0.32	71							
			+ ILMENITE? OLIVINES (?), DARK GRN	56.08	1.06	—	100							
			- 69.50 2 mm CR-DIOPSIDE	57.60	1.52	—	100							
			- 72.24 2 mm RUBY RED	59.13	1.53	—	100							
			GARNET	60.75	1.22	0.15								
				61.87	1.52	0.13								
			- 73.30 MAJOR CHANGE IN	63.25	1.38	—	100	+.08						
			ROCK, VERY COMPETENT,	64.77	1.52	—	100							
			LESS BIOTITE + CHL.	65.99	1.22	0.19								
			8-10% CALCITE FRACTURE SUB-//	67.36	1.37	—	100	NO	CORE	LOSS				
			TCA, +20% CALCITE IN MATRIX	67.97	0.61	—	100							
			AVERAGE CLAST SIZE > 20% > 4 cm	69.49	1.52	—	100							

DIAMOND DRILL LOG

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION
			76.75 3 mm ruby-red garnet, rimmed by chlorite(?)
			77.00 two rounded, olivine macrocryst ≈ 5 mm
			77.60 large biotite flake
			80.20 2 mm garnet ruby red
			80.75 two 0.5 cm macrocryst, med-bright green, rounded
			81.08 SAA
			81.55 2 mm Cr-diopside
			82.89 2 mm ruby red garnet
			83.05 SAA
			86.10 macrocryst 3 cm, rounded 20% calcite, re-brecciated kimberlite
			86.75 macrocryst, rounded, 70% olivine(?), no calcite
			86.96 macrocryst, 5 cm rounded, 20% calcite, kimberlite recycled
			87.96 2 mm ruby red garnet
			88.31 4 mm macrocryst of olivine(?), rounded
			94.58 4 mm bronzite macro, rounded,
			95.35 2 cm angular chunk of coal
			96.40 5 mm chunk of pyrite fresh
			96.60 – 98.60 sheared, 30% calcite/dolo/qtz(?)

Recovery

From - To	Int	Lost	% Rec.
69.49 - 70.71	1.22	0.40	67
72.24	1.53	—	100
73.30	1.06	—	100
75.59	2.29	—	100
76.50	0.91	—	100
78.03	1.53	—	100
79.55	1.52	—	100
80.47	0.92	—	100
81.99	1.52	—	100
84.12	2.13	—	100
85.65	1.53	—	100
87.17	1.52	—	100
88.70	1.53	—	100
90.22	1.52	—	100
91.75	1.53	—	100
93.27	1.52	—	100
94.79	1.52	—	100
96.32	1.53	—	100
97.84	1.52	—	100

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DIAMOND DRILL LOG

PROJECT NO. ______
HOLE NO. ______ Page 7 of ____

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION
			VEINLETS, ANASTAMOSING, VERY PALE GY-GRN, SOFT
		95.60	1 cm GREEN MOTTLED MACROCRYST
		95.50	3 cm ROUNDED FRAG OF LAMPROPHYRE PORPHYRY
		97.85	3 mm CIRCULAR MACRO, BRONZITE RIMMED BY BIOTITE (?)
		99-114	MANY LARGE PALE GREEN APHANITIC FRAG, SUB-ANG NO FIZZ, V. SOFT, SHALE/MUDSTONE
		106.90	MACROCRYST, 1 cm, ROUND BLACK, ZONED RIM LAMPROPHYRE?
		107.36	3 cm AA
		108.25	1 cm MACROCRYST, PALE BROWN + MID GREEN ULTRAMAFIC?
		110.20	4 mm, GREEN, ROUND MACRO OF OLIVINE
		111.40	CHROME DIOPSIDE 2 mm GRASS-GREEN
		111.70	2.5 cm MACRO, PALE GY WITH BLACK 4 mm RIM ROUNDED
		112.10	1.5 cm PALE GRN MACRO PARTLY SERPENTINIZED OLIVINE ?
		112.20	SAA
		112.40	BOTTOM CONTACT, SHARP CALCITE VEINLET 53° TCA

RECOVERY

FROM - TO	INT	LOST	% REC.
97.84 - 99.97	2.13	—	100
100.89	.92	—	100
102.41	1.52	—	100
103.94	1.53	—	100
105.46	1.52	—	100
106.99	1.53	—	100
108.51	1.52	—	100
109.73	1.22	—	100
111.40	1.67	0.10	94
112.93	1.53	—	100
114.45	1.52	—	100

SAMPLE NO.	FROM	TO	LENGTH	ANALYSES		

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DIAMOND DRILL LOG

PROJECT NO. ______
HOLE NO. ______ Page 8 of ______

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION	% REC.	SAMPLE NO.	FROM	TO	LENGTH	ANALYSES			
113.40	114.50	1.10	DYKE (?) PALE GREY WITH GREENISH TINGE, APHANITIC, MOD-HARD, MASSIVE BUT CONTAINS ANGULAR SHALE FRAGS & ABSORBED COAL FRAG. WEAK-MOD FIZZ HCL, MINOR CALCITE FRACTURES									
			TOP CONTACT 57° SHARP									
			BOTTOM CONTACT ⊥ TCA, MARKED BY CALCITE VEINLETS									

Recovery

From – To	Int	Lost	% Rec.
114.45 – 115.98	1.67	0.14	92
117.65	1.53	–	100
119.18	1.53	–	100
120.70	1.52	–	100
122.22	1.52	–	100
123.44	1.22	–	100
124.97	1.53	0.20	87
126.49	1.52	–	100
128.00	1.52	0.55	63
129.54	1.53	0.10	94
131.37	1.83	0.30	84
132.89	1.52	–	100
134.42	1.53	–	100
135.94	1.52	–	100
137.46	1.52	–	100
138.99	1.53	–	100
140.51	1.52	–	100
142.04	1.53	–	100

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DIAMOND DRILL LOG

PROJECT NO. ______
HOLE NO. ______

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION	% REC.	SAMPLE NO.	FROM	TO	LENGTH	ANALYSES			
114.50	128.00		CALCITE KIMBERLITE, SAME AS 41.82 - 113.40 m > 40% FRAGS, MAX FRAG SIZE 4 cm, MANY FRAGS ROUNDED, BLACK-BROWN, 10% BIOTITE ⇒ BRECCIA									
			119.00 2.5 cm ROUNDED, PALE-TAN KIMBERLITE FRAGMENT									
			119.17 - 119.5 PALE GREEN + BLUE GREEN MACROCRYSTS MAX 4 mm									
			119.50 . RUBY RED GARNET 2 mm.									
			112.30 MAFIC MACROCRYST, ROUNDED BLK-GREEN 3 mm									
128.00	132.50	4.50	SHEARED + BLEACHED KIMBERLITE, BROWNISH - LT GREY, STRONG SCHISTOSITY, FRAGMENTS ALIGNED ALONG SCHISTOSITY, WEAK FIZZ HCL BUT HIGHLY VARIABLE WITH MINOR STRONG REACTION, BRIGHT GREEN LIGHT STAIN ON SHEAR FACE									
			128.50 m SCHIST 25° TCA									
			129.3 " " TCA									
			130 " " TCA									
132.50	138.15		WEAKLY BLEACHED + SHEARED KIMBERLITE BRECCIA 5% OPEN VUGS, STRONG FIZZ HCL > 20% CALCITE, 1% PYRITE AS DIFFUSE PATCHES, DK GY-GREEN COLOUR TO BRECCIA, MOSTLY LMST FRAGS,									
			136.10 - 136.58 LIGHT GY-GRN DYKE, APHANITIC, WEAK FIZZ HCL									

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DIAMOND DRILL LOG

PROJECT NO. ______
HOLE NO. ______

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION				% REC.	SAMPLE NO.	FROM	TO	LENGTH	ANALYSES			
			TOP CONTACT DIFFUSE, FRAGS IN DYKE												
			BOTTOM " 25° TCA SHARP												
138.65	140.75		LT GRN-GRAY DYKE, APHANITIC, MASSIVE EXCEPT												
			TRANS FLOATING FRAGS., STRONG FIZZ HCL, >20%												
			CALCITE												
			TOP CONTACT 30° TCA												
			BOTTOM " 60° TCA												
			139.10 - 139.42 BLEACHED	RECOVERY											
			KIMBERLITE BRECCIA	FROM - TO	INT	LOST									
			T.C 25° TCA	142.04 - 143.56	1.52	—									
			B.C 40° TCA	145.08	1.52	0.10	93								
				146.61	1.53	0.33	78								
				147.83	1.22	—	100								
140.75	147.65		WEAKLY SHEARED & BLEACHED	148.13	0.30	0.07	77								
			KIMBERLITE BRECCIA, MOD-STRONG	149.66	1.53	0.54	65								
			FIZZ HCL, 1-2% PYRITE DIFFUSE	151.18	1.52	0.25	84								
				151.49	0.31	0.10	68	THREE PASSAGES OF GROUND CORE							
			- NO BIOTITE	EOH											
			- INCREASINGLY SHALE-LMST FRAGS												
			INCREASING IN SIZE TO 10 cm	BELOW	147	VERY	BROKEN								
				HOLE	ABANDONED,		NO	RETURN							
			144 - 147 WEATHERED OPEN	RODS	BINDING										
			FRACTURES, BROWN												
			ANKERITE ?												

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DIAMOND DRILL LOG

PROJECT NO. ______
HOLE NO. ______ Page 11 of 11

5800
6000

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION	% REC.	SAMPLE NO.	FROM	TO	LENGTH	ANALYSES		
147.05	151.49	4.44	DK GRAY, LIMEY, GRAPHITIC SHALE, LAMINATED + BED, STRONGLY FRACTURED AND MINOR PLASTIC DEFORMATION DISRUPTS LAMINATION								
			WEAK FIZZ HCL								
			CONTACT 45° TCA., KNIFE SHARP								
			147.05 - 147.55 FRACTURE/FLOWAGE ZONE, CALCITE FILL IN FRACTURE								
			147.55 → MINOR FRACTURING								
			149.61 LAM: 67°								
			150.50 " " 53°								
			151.49 EOH								
			HOLE ABANDONED SHORT BECAUSE OF LOST CIRCULATION, BINDING								

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DIAMOND DRILL LOG

CLIENT:	SKEENA RESOURCES LIMITED
PROJECT:	ICE PROPERTY

Area: ELKFORD, B.C.	Latitude	Bearing: 275°	Date Started: SEPT. 14/01 12.00
Contractor: LECLERC DRILLING	Departure	Inclination @ collar: -45	Date Completed
Core Size: NQ	Elevation: 1788 m = 5865'	Inclination @ ___ m, ___	Total Length: 130.15 m
		Inclination @ ___ m, ___	

Hole No.	RAM-5-04
Logged by	R. CHISHOLM
Sheet 1 of	5

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION	Recovery From - To	INT	LOST	% REC.	SAMPLE NO.	FROM	TO	LENGTH	ANALYSES
0	3.05	3.05	CASING, NO RECOVERY, RETURN REPORTED BY DRILLER AS BLUE-GRAY IN COLOUR				0					
3.05	7.93	4.88	GRN-GY-BROWN KIMBERLITE MUD WITH FRAGMENTS OF LIMEY-SHALE, NO REAL CORE, MINOR BIOTITE									
7.93	11.89	3.96	BLK-DK GRAY LIMEY SHALE / WITH MINOR INTERBEDS OF LMST. 50% OF INTERVAL IS DARK BROWN, LIMONITE STAINED, CRUMBLY WITH BROWN "MUD" SEAMS. MUD MAY BE WEATHERED KIMBERLITE, SHALE SHOWS 3% CALCITE FILLED FRACTURES, BED 45° TCA									
11.89	130.15	118.26	BLK-DK GY LIMEY SHALE									
			STRONG FILL IN NCL, 10% BROWN	3.05 - 4.88	1.83	1.68	08					
			STAINED SECTION	6.40	1.52	1.44	05					
			12.75 BED 56° TCA	7.93	1.53	1.36	11					
			16.50 " 27 TCA	8.53	0.60	0.23	62					
			18.54 -	10.06	1.53	0.26	83					
				10.36	0.30	—	100					
			22.90 BED 65 TCA	11.89	1.53	0.19	88					
			27.00 " 45 "	13.26	1.37	—	100					
			31.20 " 45 "	14.78	1.52	—	100					
			36.65 - 36.85 BROWN MUDDY SECTION	16.06	1.22	—	100					
			POSSIBLE KIMBERLITE	17.57	1.53	—	100					

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DIAMOND DRILL LOG

PROJECT NO. ____
HOLE NO. RAM-5-04 Page 2 of ____

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION				% REC.	SAMPLE NO.	FROM	TO	LENGTH	ANALYSES			
			37.50 BGO 39° TCA												
			39.93 - 40.45 MUDDY BROWN SECTION, STRONGLY WEATHERED												
			35 cm WASHED AWAY												
			40.65 BCO 30° TCA												
			43.50 " 35 TCA												
			43.85 - 44.15 BROWN WEATHERED SECTION, DISAG.												
			50.00 BCO 20° TCA												
			50.50 BCO // TCA												
			51.00 " 14° TCA	RECOVERY											
			52.00 " 18° TCA	17.53 - 18.59	1.06	—	100								
			54.40 - 54.87 BROWN WEATHERED	20.12	1.53	0.05	97								
			LIMONITE ZONE	21.64	1.52	0.30	80								
			55.30 OPEN MINOR FOLD, FOLD	22.86	1.22	0.10	92								
			AXIS ⊥ TCA	24.38	1.52	—	100								
			56.10 SAA	25.91	1.53	0.55	64								
			57.40 - 57.91 LIMONITIC VARIABLY	27.43	1.52	—	100								
			CALCITIC, MUDDY SEAM, MOSTLY	28.96	1.53	—	100								
			WASHED AWAY ⇒ KIMBERLITE?	29.26	0.30	—	100								
			60.00 BCO 33° TCA	30.18	0.92	0.28	70								
			62.50 " 25° "	32.31	2.13	0.30	86								
			63.90 - 64.25 GREENISH, CLAYEY	33.38	1.07	—	100								
			BRECCIA, NO CALCITE	33.99	0.61	0.15	75								
			64.60 - 65.10 SAA BUT COARSE	34.90	0.91	0.20	78								
			BRECCIA, ABUNDANT CALCITE	36.58	1.68	—	100								
			FRACTURES ⇒ KIMBERLITE?	38.10	1.52	—	100								
			65.50 BCO 35° TCA	39.01	0.91	0.35	62								
			70.50 " 28° TCA	39.93	0.92	—	100								
				41.45	1.52	0.30	80								

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DIAMOND DRILL LOG

PROJECT NO. ________
HOLE NO. DAM-5-04 Page 3 of ____

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION	% REC.	SAMPLE NO.	FROM	TO	LENGTH	ANALYSES
			72. S-FOLD, VERY OPEN, AXIS ⊥ TO CORE AXIS						
			74.50 BED 27° TCA						
			76.50 " 28 "						
			80.50 " 45 "						
			83.00 S-FOLD, OPEN, AXIS ⊥ TCA						
			85.00 BED 32° TCA						

Recovery

FROM - TO	INT	LOST	% REC.
41.45 - 42.98	1.53	0.45	
43.68	0.70	—	100
45.57	1.89	0.10	95
46.79	1.22	—	100
47.40	0.61	—	100
48.16	0.76	—	100
48.77	0.61	—	100
50.29	1.52	—	100
51.82	1.53	—	100
53.34	1.52	0.15	90
54.87	1.53	—	100
56.39	1.52	0.30	80
57.91	1.52	—	100
59.44	1.53	—	100
60.96	1.52	—	100
62.18	1.22	—	100
63.70	1.52	—	100
65.23	1.53	—	100
66.75	1.52	0.15	
68.13	1.38	—	100
69.34	1.21	—	100
70.41	1.07	—	100
71.63	1.22	—	100
72.85	1.22	—	100
74.37	1.52	—	100

(50.29 – 51.82): 165' → 180' COUNTING ERROR OF 10'

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DIAMOND DRILL LOG

PROJECT NO. ______
HOLE NO. ______ Page 4 of ____

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION				% REC.	SAMPLE NO.	FROM	TO	LENGTH	ANALYSES			
			89.50 BED 49° TCA												
			90.75 MINOR S-FOLD, TWO IN SERIES												
			92.20 4 cm BAND OF SOFT LIMONITIC, STRONG FIZZ HCL, GREENISH												
			BROWN, MASSIVE, DIORITE? ⇒ KIMBERLITE DYKE												
			92.80 S-FOLD, SHARP KINK												
			97.80 S-FOLD, OPEN OVER 50 cm												
				RECOVERY											
			100.75 BED 32° TCA	FROM - TO	INT	LOSS									
				74.37 - 76.05		—	100								
			~104 m SHALE GRADUALLY GRADE	77.57		—	100								
			TO POORLY LAMINATED	79.10		—	100								
			VERY LOW % OF CALCITE	80.62		—	100								
			BREAKS INTO EQUIGRANULAR	82.14		—	100								
			CHUNKS, GRAPHITIC	83.52		—	100								
			SHEAR PLANES	85.04		—	100								
			114.50 BED 50° APPROX	85.65		—	100								
				87.17		—	100								
			122.50 BED 40° TCA	88.70		—	100								
				90.22		—	100								
			CORE VERY BROKEN	91.75		—	100								
				93.27		—	100								
			NO CIRCULATION, MATERIAL	94.79		—	100								
			COLLAPSED BEHIND BIT	96.16		—	100								
			HOLE ABANDONED SHORT OF	97.69		—	100								
			138 AT 130.15.	99.21		0.25									
				100.89		0.20									
			DRILLER ADDED 10' BETWEEN	102.41		—									
			165'-180'	103.94		—									

DIAMOND DRILL LOG

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION	% REC.	SAMPLE NO.	FROM	TO	LENGTH	ANALYSES

RECOVERY

FROM - TO	INT	LOST	% REC.
103.94 - 105..		–	100
105.61		–	100
106.98		–	100
108.66		–	100
110.03			100
111.71		≈	100
113.08		≈	100
114.30		≈	
115.52		≈	
116.43		0.26	
117.96		0.25	
118.42		–	
119.18		–	
120.24		–	
121.01		0.35	
122.23		–	
123.29		.20	
124.36		.60	
125.12		.30	
126.80		.70	
128.32		.35	

(103.94 – 115.52) Very broken
Estimate of recovery only

25
36
61

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Calgary, Alberta

DIAMOND DRILL LOG

CLIENT:	SKEENA RESOURCES LIMITED
PROJECT:	ICE PROPERTY

Area: ELKFORD B.C.	Latitude	Bearing: 160°	Date Started: SEPT 21/01 10.45
Contractor: LeCLERC DRILLING	Departure	Inclination @ collar: -60	Date Completed: SEPT 22/01 10.30
Core Size: NQ	Elevation: 1788 m	Inclination @ ____ m, ____	Total Length: 167' (50.90)
		Inclination @ ____ m, ____	Hole No. RAM-5-5
			Logged by: R. CHISHOLM
			Sheet 1 of 3

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION	% REC.	SAMPLE NO.	FROM	TO	LENGTH	ANALYSES			
0	3.66	3.66	NO SIGNIFICANT RECOVERY,	0								
3.66	5.18	1.52	" "	0								
			10 cm OF SHALE FRAGMENTS IN DRILL MUD									
5.18	6.70	1.52	SAA									
6.70	9.75	3.05	15 cm OF ROUNDED FRAGMENTS LIMEY SHALE									
9.75	11.28	1.53	5 cm SAA									
11.28			COMPETENT CORE									
11.28	50.90	39.62	DARK GY-BLK LIMEY GRAPHITIC SHALE, WELL LAMINATED, STRONG FIZZ IN HCL, MINOR CALCITE FILLED FRACTURES									
			MANY NARROW SECTIONS STAINED LIMONITE-BROWN WITH LESSER SECTIONS OF BRECCIA CEMENTED BY SOFT BROWN LIMONITIC MATRIX, MOD FIZZ IN HCL FOR MATRIX									
			17.00 4 cm OF BRECCIA, CONTACTS IRREGULAR									
			17.50 5 cm ", BOTTOM CONTACT 30° TCA									
			19.50 1.5 cm " CONTACT ⊥ TCA									
			LAMINATION									
			14.00 75° TCA									
			[illegible]									

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DIAMOND DRILL LOG

PROJECT NO. ______
HOLE NO. ______ Page 2 of ____

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION	% REC.	SAMPLE NO.	FROM	TO	LENGTH	ANALYSES		
			21.00 58° TCA								
			24.00 65° TCA								
			32.00 53°								
			36.00 66°								
			42.00 65°								

Recovery

FROM - TO		INT	LOST
11.28	12.80		.15
	14.33		—
	15.85		.90
	17.37		—
	18.90		—
	20.42		—
	21.95		—
	23.47		—
	25.00		—
	26.52		—
	28.64		—
	29.57		—
	31.09		—
	32.61		—
	34.14		—
	35.66		—
	37.19		—
	38.71		—
	40.23		0.20
	41.61		0.40
	43.28		0.55

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Calgary, Alberta

DIAMOND DRILL LOG

PROJECT NO. ______
HOLE NO. ______

FROM	TO	INTERVAL	GEOLOGICAL DESCRIPTION	% REC.	SAMPLE NO.	FROM	TO	LENGTH	ANALYSES		

43.90 – 44.15 BRECCIA, ANG. FRAGS, SOFT BROWN MATRIX, WEAK-MOD FIZZ IN HCL, 35% MATRIX KIMBERLITE?

46.00 BEO 47° TCA

46.35 10 cm BAND OF BRECCIA, 40% MATRIX SOFT BROWN, NO FIZZ IN HCL ≈ 45° TCA

47.24 - 50 cm GROUND AWAY

47.70 – 48.00 BANDS OF SHALE BRECCIA ≈ 20° TCA WEAK FIZZ HCL

48.50 4 cm BAND OF SHALE BRECCIA

50 - 50.94 SHALE BRECCIA, VERY SOFT, MUDDY BROWN, WEAK-MOD FIZZ HCL, MORE COMPETENT AFTER 50.60, > CALCITE CEMENT PROBABLY KIMBERLITE

RECOVERY

FROM - TO	INT	LOST	
43.28 – 44.81		.05	
46.18		—	
47.24		0.50	GROUND FROM BOTTOM OF INTERVAL
48.62		—	
50.00		0.10	
50.90		—	
50.94		—	

WATER TRUCK BROKEN DOWN, NO WATER, HOLE ABANDONED AT 167', CASING PULLED AS PER CLIENT REQUEST

PETROGRAPHIC EVALUATION OF KIMBERLITE THIN SECTIONS FROM THE SKEENA RESOURCES ICE DIAMOND PROPERTY, SOUTHEASTERN BRITISH COLUMBIA

Prepared for:
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February-April 2002

PETROGRAPHIC EVALUATION OF KIMBERLITE THIN SECTIONS FROM THE SKEENA RESOURCES ICE DIAMOND PROPERTY, SOUTHEASTERN BRITISH COLUMBIA

February-April, 2002

INTRODUCTION

A petrographic examination was conducted on 59 thin sections to determine the lithologic nature of trench and drill core material obtained from two kimberlite pipes on the Skeena Resources Ice Diamond Property in southeastern British Columbia. A total of 41 thin sections prepared from sample material obtained from a blasted trench in the Bonus pipe and 18 prepared from core samples from the Ram-6 pipe were examined. The Bonus pipe samples include 14 standard size thin sections and 17 oversize sections. Thin sections from the Ram-6 pipe were cut from core from the 101.1, 110.2 and 137.15 metre levels of drill hole RAM-6-3 DDH. Thin sections from the various Ram-6 levels are as follows: 101.1 metre level -- 5 standard size and 4 oversize; 110.2 metre level – 3 standard size and 5 oversize; 137.15 metre level – 1 oversize. All thin sections were described microscopically utilizing a Nikon petrographic microscope with transmitted and reflected light capabilities. Representative photomicrographs were taken to demonstrate rock textures and special features. Thin sections that are very similar to previously described sections were not described in detail. Tiny angular to subangular grains of grinding compound are abundant in all samples.

SUMMARY OF PETROGRAPHY

Thin sections evaluated from the Ram-6 and Bonus pipes exhibit considerable differences but do reflect a probable common source. The Ram-6 samples indicate a much higher position in the pipe system in that they are all diatreme facies breccias, whereas the Bonus samples are all hypabyssal facies kimberlite. However, the Bonus samples also could reflect a blind diatreme system, plug or dyke. Sample suites from both pipes contain abundant macrocrysts and microcrysts of serpentinized olivine, as well as relatively common phlogopite, but serpentinized olivine grains in Ram-6 samples typically are extensively silicified. Xenocrysts of spinel, ilmenite, clinopyroxene and rare pyrope garnet also are present, and many peridotite nodules were encountered. Several generations of autoliths occur in both pipe systems, and in many Ram-6 samples, some pelletal lapilli are cored by autoliths. A number of autoliths in both pipes are cored by peridotite and many are multiple generation composite features. The extent of alteration in the Ram-6 samples precludes identification of primary groundmass mineral phases thus a definite lithologic designation is not possible. Features present in the Ram-6 samples are also characteristic of ultramafic lamprophyres (aillikites). However, the similarity of autoliths and general groundmass components in the Bonus and Ram-6 pipes, and their close proximity to one another would tend to support a kimberlite designation for samples from both pipes.

Three distinct types of kimberlite are present in the evaluated suite of thin sections. All samples from the Bonus Pipe are hypabyssal facies kimberlite, most of which is autolithic, macrocrystic, opaque mineral/perovskite bearing or rich, calcite serpentine kimberlite with weakly to strongly developed segregationary texture. The Ram-6 samples are all diatreme facies kimberlite breccias of two significantly different types, except for the single sample from the 137.46 metre level that appears to be a sedimentary rock. Samples from the 101.10 metre level are essentially all weakly foliated, variably carbonatized, silicified serpentinized olivine macrocryst/microcryst/fragment-rich, diatreme facies kimberlite heterolithic breccias, with abundant altered sedimentary wallrock clasts, autoliths and pelletal lapilli. Samples from the 110.2 metre level, although somewhat similar to those from the shallower zone, all are prominently crystallinoclastic, the abundant groundmass clast population dominated by quartz and feldspar. The autolith-pelletal lapilli population tends to be lower than in samples from the 101.10 metre zone, but compositions of the population are comparable. The wallrock xenolith content also is in general lower than 101.1 metre level samples, but the wallrock mineral clast content is extraordinarily high. It appears that the lower level breccia phase may be somewhat younger than the upper level phase, and was derived from a source with a very high component of disaggregated quartz/feldspar rich wallrocks. The percentage of wallrock component dilution in this phase is significantly greater than in the upper level breccia unit.

The single sample from the 137.46 metre level is a weakly pyritic, locally conglomeratic (primarily self-pebble), fine grained, calcareous arenaceous mudstone. Sand and silt grains of quartz and minor feldspar are mostly angular to subangular, but several irregular zones of intercalated mudstone contain somewhat coarser and more rounded grains. Rounded to subrounded pebbles of calcareous mudstone and lesser shale and carbonate are locally abundant, and range to 6mm. Although the groundmass of this rock may originally have been primarily clay, it is now essentially all finely crystalline carbonate. The sand and silt size grains of quartz and feldspar in this rock are identical to those in the groundmass of the 110.2 metre level crystallinoclastic kimberlite breccia. The latter likely were derived from disaggregation of similar source rocks. Although this sample may be from a block of wallrock within the Ram-6 pipe, it also might indicate that the drill hole has passed through the kimberlite-wallrock contact.

<u>Bonus pipe samples</u> are all hypabyssal, macrocrystic/microcrystic, have segregationary texture, and contain abundant autoliths that may reflect at least four generations or phases of kimberlite. Varying degrees of carbonate replacement may be present, but autoliths generally exhibit more extensive carbonatization than host kimberlite. Autoliths and host kimberlite typically are enriched in opaque minerals (mostly spinel but locally abundant sulfides including pyrite, pyrrhotite and millerite), and variably altered perovskite and phlogopite are relatively abundant in some autoliths. Although modest to significant variations may be present between individual samples, material from the Bonus pipe trench might best be designated as **variably carbonatized, autolithic (globular segregations or nucleated autoliths common), macrocrystic/microcrystic,**

hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with segregationary texture.

Most thin sections are dominated by well rounded to subrounded autoliths that comprise more than half of the total volume of some sections. Slightly less abundant volumetrically are macrocrysts and microcrysts of serpentinized olivine, and xenocrysts of phlogopite are relatively common. Intensely altered, subangular fragments of crustal sedimentary wallrock are present as are a few extensively altered diorite (?) and lamprophyre (?) clasts, but these do not comprise a significant percentage of any sample. Extensively altered, well rounded peridotite nodules occur in several samples, typically as cores in autoliths. Microcrysts (and rare macrocrysts) of spinel and ilmenite occur in most samples, spinel being more abundant. Many of the spinel grains have thin opaque rims of probable titanomagnetite, and ilmenite xenocrysts typically are rimmed by granular aggregates of titanomagnetite, perovskite +/- rutile and/or anatase and/or titanite. The autolith, xenolith and xenocryst populations are set in a finely crystalline groundmass of roughly equant, blocky crystals of serpentine and calcite with abundant tiny grains of opaque minerals and variably altered perovskite. Much of the groundmass serpentine appears to be pseudomorphic after microphenocrysts of olivine, and these are replaced locally by calcite. Irregular pools of relatively coarse calcite and/or optically contiguous, locally recrystallized serpentine (serpophite?) are abundant. Although some pools are comprised entirely of serpentine, more commonly, calcite borders and/or penetrates into serpentine pools or is the sole occupant of pool areas. Many macrocrysts and microcrysts of serpentinized olivine are characteristically necklaced by fine grains of opaque minerals and perovskite. This same feature is present in opaque mineral rich autoliths. Perovskite is moderately abundant in both host kimberlite and most autoliths, but typically is partially to completely altered to mixtures of kassite [$CaTi_2O_4(OH)_2$], anatase and titanite (sphene). Small grains and irregular masses of pyrrhotite and fine needles of millerite commonly occur within serpentinized olivine macrocrysts and microcrysts, especially those in autoliths, and tiny crystals to irregular aggregates of pyrite are disseminated through most samples.

Autoliths and serpentinized olivine macrocrysts clearly dominate the Bonus pipe samples. At least four types of autoliths are present, and some of these range to 4cm across. However, the numerically most common autolith type (**<u>Type 1</u>**) ranges from about 1-5mm, is rounded to subrounded, and generally cored by a serpentinized olivine macrocryst. Some lack cores and others are cored by phlogopite or spinel macrocrysts, or intensely altered and carbonatized wallrock fragments. These autoliths are all texturally and mineralogically very similar to the host kimberlite, being macrocryst, microcryst and opaque mineral/perovskite-rich, but they generally lack pool calcite and serpentine. They are also mineralogically rather similar to much of the "accretionary" kimberlite in the nucleated autoliths, although the latter typically contain some layers with relatively abundant pool calcite and serpentine, and commonly are more enriched in phlogopite. These small autoliths might best be classified as **weakly carbonatized, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite.** A few autoliths similar to the Type 1 variety and referred to as **<u>Type 1A</u>** are characterized by very high opaque mineral/perovskite content (as much as 10-20 %) and small to moderate numbers of serpentinized olivine microcrysts. Smaller microcrysts are completely carbonatized, but the larger microcrysts exhibit only partial replacement by carbonate. Microcrysts typically are necklaced by opaque oxides and perovskite, as are those in Type 1 autoliths and host kimberlite. The groundmass of these autoliths is characteristically very fine grained and dominated by carbonate, much of which appears to be pseudomorphic after microphenocrysts and tiny microcrysts of serpentinized olivine. These grains are set in mesostasis of microcrystalline to cryptocrystalline serpentine and carbonate with minor small laths of phlogopite. Except for the exceptionally high opaque oxide/perovskite content of these autoliths, they are very similar to Type 1 autoliths and host kimberlite. Consequently, they are referred to as Type 1A autoliths and might best be designated as **weakly carbonatized, macrocrystic, hypabyssal, phlogopite-bearing, perovskite opaque mineral calcite serpentine kimberlite.** One Type 1 autolith in Sample #40 contains a small well rounded autolith that is similar to Type 1 autolith kimberlite in containing macrocrysts and microcrysts of variably carbonatized serpentinized olivine and moderate amounts of opaque oxides and perovskite, some of which necklace olivine macrocrysts and microcrysts. Furthermore, it has a groundmass of variably carbonatized microphenocrysts and tiny microcrysts of serpentinized olivine in a mesostasis of microcrystalline to cryptocrystalline serpentine, locally replaced by carbonate, and small laths of locally chloritized phlogopite. However, it is characterized by the presence of abundant, randomly oriented prisms (as much as 0.22mm long) of completely carbonatized apatite. This autolith is referred to as Type 1B, and is composed of **moderately carbonatized, microcrystic/macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, apatite calcite serpentine kimberlite**.

The most impressive autoliths in the Bonus pipe sample suite are large (as much as several cm), rounded, concentrically layered, cored features that commonly cover much of a thin section, and are referred to as **Type 2** autoliths. As indicated above, these are compositionally quite similar to the Type 1 autolith population, but they are somewhat more enriched in serpentinized olivine microcrysts, opaque minerals, perovskite and phlogopite, and locally contain segregationary pools of calcite and serpentine. Furthermore, altered peridotite nodules commonly core them. The most prominent feature of these autoliths is a concentrically layered texture and parallel to subparallel alignment of elongate mineral grains. Layers range from a few hundred microns to several millimetres in width, and are defined by variable concentrations of serpentinized olivine macrocrysts and microcrysts, phlogopite xenocrysts, opaque minerals and perovskite, and segregationary pools of calcite +/- serpentine. These large concentrically layered autoliths are similar to features referred to as nucleated autoliths by Ferguson et al. (1973) and Danchin et al. (1975). The latter authors suggested that these features developed by magmatic crystallization about nucleating centers. Rounded cored autoliths of this type (either with or without concentric layering) in hypabyssal kimberlite are currently generally referred to as globular segregations (e.g., Clement, 1982; Mitchell, 1986). Those with concentric layering might be considered accretionary. These cored or nucleated autoliths or cored globular segregations as they might be called are composed of **weakly carbonatized, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with local segregationary texture** and are referred to as Type 2 autoliths.

The third type of autolith (**Type 3**) is characteristically enriched in phlogopite (commonly in excess of 10%), opaque minerals and altered perovskite, and locally contains segregationary pools of calcite +/- serpentine. The matrix consists primarily of a finely crystalline mixture of serpentine and calcite, but generally is not dominated by serpentinized olivine microphenocrysts. Most of the carbonate, other than in pools, appears to be secondary. It might best be referred to as **weakly carbonatized, macrocrystic, hypabyssal, perovskite/opaque mineral-rich, calcite phlogopite serpentine kimberlite with minor segregationary texture.** A variant of this autolith type (referred to as **Type 3A**) also is moderately enriched in phlogopite but its opaque oxide/perovskite content is significantly lower, even than Type 1 and 2 autoliths. It also contains a significant amount of microphenocrysts and tiny microcrysts of serpentinized olivine pseudomorphed by calcite, and microcrystalline serpentine is relatively abundant in the matrix. Furthermore, serpentine in macrocrysts and microcrysts is considerably less carbonatized than in most other autoliths. Small segregationary pools of calcite +/- serpentine are present but rare. This Type 3A autolith variety might best be described as a **weakly carbonatized, macrocrystic, hypabyssal, perovskite/opaque mineral-bearing, phlogopite calcite serpentine kimberlite.**

The fourth autolith type (**Type 4**) is characterized by relatively extensive carbonatization, low opaque mineral-perovskite content, lower concentration of serpentinized olivine macrocrysts and large microcrysts, a very abundant population of small microcryst (< 0.3mm) of altered olivine, and a groundmass with fewer carbonatized, serpentinized pseudomorphs of microphenocrystic olivine. Partially to completely carbonatized serpentinized olivine microcrysts are set in a dusky matrix of carbonate and variable amounts of microcrystalline and cryptocrystalline serpentine. Small laths of groundmass phlogopite are relatively common, and these generally are partially replaced by chlorite and/or carbonate. Minor irregular small pools of serpentine and/or carbonate also are present. Pool serpentine commonly is recrystallized to very fine grained aggregates. Intensely altered and carbonatized, angular fragments of wallrock material are present locally. Type 4 autoliths might best be described as **extensively carbonatized, weakly macrocrystic strongly microcrystic, hypabyssal, perovskite, opaque mineral and phlogopite-bearing, serpentine kimberlite, with minor segregationary texture.** A variant of this autolith type (referred to as **Type 4A**) was observed in several thin sections. These autoliths typically are subangular to subrounded and commonly include small autoliths of Type 3A kimberlite material. Furthermore, some are partially rimmed by apparent Type 3A kimberlite. This variant has a slightly greater concentration of macrocrysts and large microcrysts than normal Type 4 kimberlite, but these autoliths are similarly extensively replaced by carbonate. However, the groundmass is considerably less carbonatized and microcrystalline serpentine is very abundant (generally more than 50% of the mesostasis). Some of the groundmass serpentine appears to reflect pool material that has been partially to completely recrystallized and partially replaced by carbonate. Phlogopite tends to be less abundant, although commonly occurs as a decussate array of larger laths that similarly are partially chloritized but more commonly are completely carbonatized. Opaque oxides and perovskite are moderately abundant, and commonly necklace macrocrysts and larger microcrysts of serpentinized olivine. These Type 4A autoliths may be described as

carbonatized, moderately macrocrystic, hypabyssal, perovskite, opaque mineral and phlogopite-bearing, serpentine kimberlite, with relict segregationary texture.

Overall age relationships of the autolith suite are very imprecise, although Type 1 autoliths clearly are youngest, followed by Type 1B, Type 1A and Type 2 (accretionary autoliths). Type 3 and 3A autoliths appear to be older than Type 4 and 4A, being commonly enclosed by the latter, but a few 4A autoliths are partially rimmed by apparent 3A kimberlite. No age difference can be established between Type 3 and 3A autoliths, but Type 4 autolith kimberlite locally rims or is intergrown with Type 4A autoliths. The best attempt at establishing a chronological sequence for the autolith population is, from oldest to youngest, as follows: Type 3 > or = Type 3A > and locally < Type 4A > Type 4 > Type 2 > Type 1A > Type 1B > Type 1. However, as indicated, Type 3A autolith kimberlite or comparable material locally rims Type 4A autoliths, suggesting that at least some residual 3A melt (or chemically similar melt) was available after crystallization of at least some 4A melt.

Type 3, 3A and 4 autoliths appear to be represented in at least some of the Ram-6 pipe samples. The presence of these autoliths infers that both the Ram-6 and Bonus pipe kimberlite melts passed through a common source area. An interesting realm for speculation is the relative potential diamond content of the different autolith types. However, regardless of possible differences in autolith diamond content, it is safe to state that the Bonus pipe kimberlite with high concentrations of autoliths and low concentrations of wallrock material, is more likely to have a higher diamond grade than the tested portions of the Ram-6 pipe (at least at those levels represented by evaluated thin section suites).

The Ram-6 101.10 metre level samples are all **weakly to moderately foliated, variably carbonatized, silicified serpentinized olivine macrocryst/microcryst/fragment-rich, diatreme facies kimberlite heterolithic breccia, with abundant altered sedimentary wallrock clasts, autoliths and pelletal lapilli.** Foliation is imparted primarily by the varying degree of alignment of elongate macrocrysts and macrocryst fragments of silicified serpentinized olivine, along with phlogopite macrocrysts and elongate sedimentary rock xenoliths. A parallel preferred alignment defined by silicified serpentinized olivine microcrysts, phlogopite laths and small lithic fragments is present locally, and the relatively pronounced orientation of both small and large scale features infers a significant component of "flow" during emplacement of the kimberlite breccia. This flow (?) foliation is accentuated by the presence of many thin (< 0.1mm wide) veinlets of locally finely fibrous gypsum +/- Ca-zeolites (e.g., thomsonite or heulandite) +/- aragonite (or fibrous calcite) +/- strained quartz that tend to parallel or subparallel the roughly planar rock fabric.

Sedimentary rock clasts comprise as much as half of any given thin section, but generally account for about a quarter or third of the total volume. This population is dominated by shales and fine to course grained carbonates, but siltstone and probable oil shale also are present. However, most of the argillaceous and arenaceous material has been substantially carbonatized. Other intensely altered xenoliths include probable pyroxenite and lamprophyre, and some carbonatized granitoids may be present. Several small, extensively altered nodules of peridotite also were observed, but these all serve as cores to autoliths. Pelletal lapilli and autoliths are relatively abundant and comprise from 10-20% of the thin section volume in most samples. Lapilli and autoliths range to as much as 4mm long but generally are less than 1mm, especially the non-cored varieties. The lapilli:autolith ratio is quite variable, but autoliths tend to dominate in most sections. Pelletal lapilli typically are cored by silicified serpentinized olivine macrocrysts or macrocryst fragments, but many are cored by wallrock xenoliths or autoliths. Alignment of elongate minerals parallel or subparallel to core boundaries is relatively common in many cored lapilli, but mineral alignment is essentially absent in non-cored lapilli and autoliths. Kimberlite comprising pelletal lapilli tends to be finer grained, lower in opaque minerals, perovskite, and phlogopite, and more intensely carbonatized than autolith and breccia matrix kimberlite. Most lapilli kimberlite is dominated by microcrysts and microphenocrysts of almost completely carbonatized, variably silicified, serpentinized olivine set in a matrix composed primarily of microcrystalline serpentine that is extensively to completely replaced by carbonate and, locally, cryptocrystalline quartz. This material might best be designated as **predominantly cored, intensely carbonatized, microcrystic, opaque mineral-perovskite-phlogopite-bearing, variably silicified serpentine kimberlite lapilli.**

Both cored and non-cored autoliths are relatively abundant, and a few are mantled by a second generation of pre-lapilli kimberlite. Autolith kimberlite tends to be somewhat lower in silicified serpentinized olivine microcrysts than lapilli kimberlite, typically contains silicified serpentinized olivine macrocrysts, relatively abundant phlogopite microcrysts, variable amounts of groundmass phlogopite, and slightly higher to considerably higher concentrations of opaque minerals and altered perovskite. Autolith macrocrysts and microcrysts of silicified serpentinized olivine exhibit only limited carbonatization, although serpentinized olivine microphenocrysts and finely crystalline groundmass serpentine generally are almost completely replaced by carbonate. The autoliths are petrographically similar to some of the autoliths (primarily Types 3A, 3 and 4) described in Bonus pipe samples, although the probable Type 3A and 3 populations tend to be more enriched in phlogopite microcrysts and microphenocrysts of carbonatized serpentinized olivine. However, these autoliths probably share a common source. Most of the autolith kimberlite (Type 3A and 3) might best be described as **variably carbonatized, macrocrystic/microcrystic, hypabyssal, perovskite/opaque mineral-phlogopite-bearing (or rich), calcite serpentine kimberlite.** The more limited probable Type 4 autoliths are described as **extensively carbonatized, weakly macrocrystic strongly microcrystic, hypabyssal, perovskite, opaque mineral and phlogopite-bearing, serpentine kimberlite, with minor segregationary texture.** Many autoliths and lapilli are characterized by the rather pervasive presence of irregular patches of brown to dark brown, isotropic material that also is present locally in the interclast host kimberlite. This material may be kerogen derived from oil shale incorporated from the wallrock, although at least some may be mixtures of Fe-oxyhydroxides.

The xenocryst population may comprise more than 30% of the total rock volume, but generally ranges between about 20-30%. The population is dominated by silicified serpentinized olivine macrocrysts, microcrysts and macrocryst fragments. The serpentinized olivine has been extensively silicified, larger grains characterized by interior zones (areas where antigorite generally predominates) of moderately coarse interlocking bladed crystals, and border zones and internal fracture plane areas (where chrysotile predominates) generally replaced by microcrystalline to cryptocrystalline quartz with variable amounts of fibrous talc. Talc tends to be coarsest at contacts between macrocrystalline and microcrystalline/cryptocrystalline replacement quartz. Smaller grains typically are completely replaced by microcrystalline and cryptocrystalline quartz and talc. Macrocrysts, macrocryst fragments and large microcrysts generally exhibit only minor replacement by carbonate, whereas microcrysts commonly are partially to completely carbonatized. Some variably silicified serpentinized macrocrysts contain irregular subrounded zones of apparently contiguous, very pale green lizardite (?) that characteristically exhibits strain, very low birefringence and 2V (essentially 0), and an apparent uniaxial negative sign. The larger silicified serpentinized olivine grains commonly contain variable amounts of irregular opaque minerals (possibly pyrrhotite) and fine needles of millerite. Macrocrysts (in excess of 1mm) and microcrysts of essentially fresh phlogopite are relatively common. Slightly less common are angular to subrounded microcrysts of spinel (many grains rimmed by titanomagnetite) that range to about 0.5mm, and ilmenite microcrysts also are present. Rare macrocrysts and microcrysts of clinopyroxene also were observed. Angular to subrounded microcrysts of carbonate and quartz occur locally but are not abundant.

The groundmass of this heterolithic breccia consists of a mixture of weakly to extensively carbonatized microcrysts and macrocryst fragments of silicified serpentinized olivine, small comminuted fragments of intensely altered, carbonate dominated sedimentary wallrocks, variably chloritized and/or serpentinized microcrysts of phlogopite, and small grains of opaque minerals and altered perovskite. These clasts and mineral grains are set in a matrix of finely crystalline calcite and variably carbonatized microcrystalline to cryptocrystalline serpentine. Some of the calcite appears to be pseudomorphic after microphenocrysts or comminuted fragments of serpentinized olivine. Many irregular areas and stringer-like zones (some in excess of 1mm) between clasts are filled with gypsum (?) and/or Ca-rich zeolites similar to material present in veinlets. Minor irregular zones of strained quartz also are present. Small grains of pyrite are disseminated throughout the samples, occurring in xenoliths, autoliths and host kimberlite.

The Ram-6 110.2 metre level samples, although somewhat similar to those from the shallower zone, are all prominently crystallinoclastic. They are **weakly to moderately foliated, variably carbonatized, silicified serpentinized olivine macrocryst/microcryst/fragment-rich, crystallinoclastic, diatreme facies kimberlite heterolithic (or lithic) breccias, with abundant altered sedimentary wallrock clasts, moderately abundant autoliths and relatively rare pelletal lapilli.** As in the 101.1 metre level samples, foliation is imparted primarily by elongate macrocrysts, microcrysts and macrocryst fragments of silicified serpentinized olivine, along with phlogopite macrocrysts and microcrysts and elongate sedimentary rock clasts. Varying degrees of alignment also are present locally in interclast groundmass mineral grain and microclast components. This apparent "flow" foliation also is accentuated by parallel to subparallel veinlets of gypsum +/- Ca-zeolites +/- carbonate (aragonite ?) +/- quartz, although quartz is more abundant than in shallower level veins

Sedimentary rock clasts dominate the xenolith population as in 101.1 metre level samples, but account for less of the total rock volume. Autoliths tend to be less abundant and pelletal lapilli are significantly less abundant. Intensely altered shales are most common, but carbonates, siltstone and oil shale also are present. Other xenoliths observed in these samples are intensely altered, probable pyroxenite, lamprophyre, and granitoids. Autoliths comprise from about 5 to 15% of the thin section volume, and they are essentially the same texturally and compositionally as those in 101.1 metre level samples. However, silicified serpentinized olivine in some samples is more extensively replaced by carbonate. Pelletal lapilli are considerably less abundant, rarely exceeding 5% of total rock volume. As in 101.1 metre level samples, most are cored, and the kimberlite typically is fine grained, lower in opaque minerals, perovskite and phlogopite, and is more intensely carbonatized. The large xenocryst population (silicified serpentinized olivine macrocrysts/macrocryst fragments/large microcrysts, phlogopite, spinel, ilmenite, clinopyroxene) is comparable to that in 101.1 metre level samples, although commonly concentrations are somewhat lower. However, the small xenocryst population is dramatically different. Angular to subangular (rarely rounded) clasts of quartz and lesser feldspar comprise from 10% to nearly 50% of breccia groundmass areas. Some carbonate clasts also are present, but most clast-like carbonate appears to be pseudomorphic after microcrysts and microphenocrysts of serpentinized olivine. The remainder of the groundmass is essentially the same as that in 101.1 metre level samples. Abundant small microcrysts and microphenocrysts of completely carbonatized, serpentinized olivine are set in a matrix of apparently microcrystalline to cryptocrystalline serpentine that has been almost entirely replaced by carbonate and cryptocrystalline quartz. Isolated laths of phlogopite also are present, and small grains of opaque minerals and altered perovskite are relatively common. Irregular areas filled with gypsum +/- Ca-zeolites +/- aragonite (or fibrous calcite) +/- quartz are relatively abundant. The quartz content of these zones appears to be greater than comparable groundmass areas in shallower level samples. As in 101.1 metre level samples, breccias from the 110.2 metre level also contain abundant small grains of pyrite disseminated throughout.

This lower level breccia clearly was derived from a source with a wallrock contribution high in quartz and lesser feldpar. These mineral clast components likely are disaggregation products from a sandy mudstone comparable to that encountered at the 137.46 metre level. Because of the high concentration of wallrock mineral clasts, the percentage of dilution in this kimberlite breccia phase is significantly greater than in the upper level breccia unit.

LIST OF ASSIGNED ROCK TYPES

Bonus Pipe--Thin Sections from Hand Samples from Blasted Trench

#1 (oversize) **A nucleated (or accretionary) autolith (or globular segregation) dominated, weakly carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with segregationary texture.**

#2 (oversize) **A nucleated (or accretionary) autolith (or globular segregation) dominated, weakly carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with segregationary texture.**

#4 (oversize) **A weakly carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with segregationary texture and multiple generations of autoliths (at least 4).**

#6 (oversize) **A weakly carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with segregationary texture and multiple generations of autoliths (at least 4).**

#7 (oversize) **A weakly carbonatized, autolithic (accretionary or globular segregation dominated), macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with segregationary texture and multiple generation autoliths, including composite autoliths.**

#8 (oversize) **A weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture.**

#9 (oversize) **A weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite, serpentine kimberlite with pronounced segregationary texture.**

#10 (oversize) **A weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite, serpentine kimberlite with pronounced segregationary texture.**

#12 (oversize) **A weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture and multiple composite autoliths.**

#13 (oversize) **A weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture.**

#14 (oversize) **A weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture.**

#15 (oversize) **A weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture and multiple generation composite autoliths.**

#16 (oversize) **A moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture and multiple generation composite autoliths.**

#17 (standard size) **A weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture.**

#18 (standard size) **A moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, and several multiple generation composite autoliths.**

#20 (oversize) **A moderately carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with segregationary texture, multiple generation autoliths, and a spinel lherzolite nodule coring an accretionary or nucleated autolith (globular segregation).**

#21 (oversize) **A moderately carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with segregationary texture, and a spinel lherzolite nodule coring a nucleated accretionary autolith (globular segregation).**

#22 (oversize) **A moderately carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with segregationary texture, and a spinel lherzolite nodule coring a nucleated accretionary autolith (globular segregation).**

#23 (oversize) **A moderately carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with segregationary texture, multiple generation autoliths, and a spinel lherzolite nodule coring a nucleated accretionary autolith (globular segregation).**

#24 (oversize) **A weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, and multiple generation autoliths.**

#25 (oversize) **A weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, multiple generation autoliths, and two globular segregation (accretionary) autoliths.**

#26 (oversize) **A weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, multiple generation autoliths, and one globular segregation (accretionary) autolith.**

#27 (oversize) **A weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, multiple generation autoliths, and three globular segregation (accretionary) autoliths (one with a spinel harzburgite? core).**

#28 (oversize) **A weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, multiple generation autoliths, and a single nucleated accretionary autolith (globular segregation) with a spinel lherzolite core.**

#29 (oversize) **A weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, multiple generation autoliths, and a single nucleated accretionary autolith (globular segregation) with a spinel lherzolite core.**

#30 (oversize) **A weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, multiple generation autoliths, and two nucleated accretionary autoliths (globular segregations) with spinel lherzolite cores.**

#31 (oversize) **A weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture and multiple generation autoliths.**

#32 (oversize) **A weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, multiple**

generation autoliths, and three nucleated accretionary autoliths (globular segregations), one with a spinel lherzolite core.

#33 (oversize) **A weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, multiple generation autoliths, and a single nucleated accretionary autoliths (globular segregations) with a spinel lherzolite core.**

#34 (standard size) **A weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, multiple generation autoliths, and a single nucleated accretionary autoliths (globular segregations) with a spinel lherzolite core.**

#35 (standard size) **A weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, multiple generation autoliths, and a single nucleated accretionary autoliths (globular segregations) with a spinel lherzolite core.**

#36 (standard size) **A weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, multiple generation autoliths, and a single nucleated accretionary autoliths (globular segregations) with a spinel lherzolite core.**

#37 (standard size) **A Type 2 nucleated accretionary autolith of moderately carbonatized, macrocrystic/microcrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with local segregationary texture, mantling a spinel lherzolite nodule.**

#38 (standard size) **A moderately carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral rich, calcite serpentine kimberlite with pronounced segregationary texture and multiple generation autoliths.**

#39 (standard size) **A moderately carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral rich, calcite serpentine kimberlite with pronounced segregationary texture.**

#40 (standard size) **A moderately carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral rich, calcite serpentine kimberlite with pronounced segregationary texture and multiple generation autoliths.**

#41 (standard size) **A moderately carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral rich, calcite serpentine kimberlite with segregationary texture and multiple generation autoliths.**

#42 (standard size) **A moderately carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral rich, calcite serpentine kimberlite with segregationary texture and multiple generation autoliths.**

#43 (standard size) **A moderately carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral rich, calcite serpentine kimberlite with segregationary texture and multiple generation autoliths.**

#44 (standard size) **A moderately carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral rich, calcite serpentine kimberlite with segregationary texture, multiple generation autoliths and a small spinel lherzolite nodule.**

#45 (standard size) **A moderately carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral rich, calcite serpentine kimberlite with segregationary texture and multiple generation autoliths.**

Ram-6 Diatreme—Thin Sections from Core Samples from Ram-6-3 DDH

101.10 Metre Interval

R-3 (101.10 m, standard size) **A weakly foliated, variably carbonatized, silicified serpentinized olivine macrocryst/microcryst/fragment-rich, diatreme facies kimberlite heterolithic breccia, with abundant altered sedimentary wallrock clasts, autoliths and pelletal lapilli (?).**

R-4 (101.10 m, standard size) **A weakly foliated, variably carbonatized, silicified serpentinized olivine macrocryst/microcryst/fragment-rich, diatreme facies kimberlite lithic breccia, with abundant altered sedimentary wallrock clasts, and minor pelletal lapilli (?) and autoliths.**

R-5 (101.10 m, standard size) **A weakly foliated, variably carbonatized, silicified serpentinized olivine macrocryst/microcryst/fragment-rich, diatreme facies kimberlite heterolithic breccia, with abundant altered sedimentary wallrock clasts, autoliths and pelletal lapilli (?).**

R-6 (101.10 m, standard size) **A very weakly foliated, variably carbonatized, silicified serpentinized olivine macrocryst/microcryst/fragment-rich, autolithic, diatreme facies kimberlite heterolithic breccia, with abundant altered sedimentary wallrock clasts, autoliths and pelletal lapilli (?).**

R-7 (101.10 m, oversize) **A moderately foliated, variably carbonatized, silicified serpentinized olivine macrocryst/microcryst/fragment-rich, diatreme facies kimberlite heterolithic breccia, with abundant pelletal lapilli and altered sedimentary rock fragments, minor autoliths, and a garnet macrocryst .**

R-8 (101.10 m, oversize) **A moderately foliated, variably carbonatized, silicified serpentinized olivine macrocryst/microcryst/fragment-rich, diatreme facies kimberlite heterolithic breccia, with abundant pelletal lapilli and altered sedimentary rock fragments, minor autoliths, and two garnet macrocrysts.**

R-9 (101.10 m, oversize) **A moderately foliated, variably carbonatized, silicified serpentinized olivine macrocryst/microcryst/fragment-rich, diatreme facies kimberlite heterolithic breccia, with abundant pelletal lapilli, autoliths and altered sedimentary rock fragments.**

R-10 (101.10 m, oversize) **A moderately foliated, variably carbonatized, silicified serpentinized olivine macrocryst/microcryst/fragment-rich, diatreme facies kimberlite heterolithic breccia, with abundant pelletal lapilli and altered sedimentary rock fragments, and minor autoliths.**

R-11 (101.10 m, standard size) **A weakly foliated, variably carbonatized, silicified serpentinized olivine macrocryst/microcryst/fragment-rich, diatreme facies kimberlite heterolithic breccia, with abundant altered sedimentary wallrock clasts, autoliths and pelletal lapilli.**

110.20 Metre Interval

R-12 (110.20 m, standard size) **A weakly foliated, autolith bearing, variably carbonatized, silicified serpentinized olivine microcryst/macrocryst fragment/macrocryst-rich, crystallinoclastic, diatreme facies kimberlite heterolithic breccia, with abundant intensely altered sedimentary wallrock clasts.**

R-14 (110.20 m, standard size) **A moderately foliated, variably carbonatized, autolith bearing, silicified serpentinized olivine macrocryst/microcryst/macrocryst fragment-rich, crystallinoclastic, diatreme facies kimberlite heterolithic breccia, with abundant altered sedimentary wallrock clasts.**

R-15 (110.20 m, standard size) **A weakly foliated, variably carbonatized, autolith bearing, silicified serpentinized olivine macrocryst/microcryst/macrocryst fragment-rich, strongly crystallinoclastic, diatreme facies kimberlite lithic breccia.**

R-16 (110.20 m, oversize) **A weakly foliated, variably carbonatized, autolith bearing, silicified serpentinized olivine macrocryst/microcryst/macrocryst fragment-rich, strongly crystallinoclastic, diatreme facies kimberlite lithic breccia.**

R-18 (110.20 m, oversize) **A weakly foliated, variably carbonatized, autolith bearing, silicified serpentinized olivine macrocryst/microcryst/macrocryst fragment-rich, crystallinoclastic, diatreme facies kimberlite lithic breccia.**

R-19 (110.20 m, oversize) **A weakly foliated, variably carbonatized, autolith bearing, silicified serpentinized olivine macrocryst/microcryst/macrocryst fragment-rich, crystallinoclastic, diatreme facies kimberlite lithic breccia, with a garnet macrocryst.**

R-20 (110.20 m, oversize) **A weakly foliated, variably carbonatized, autolith bearing, silicified serpentinized olivine macrocryst/microcryst/macrocryst fragment-rich, crystallinoclastic, diatreme facies kimberlite lithic breccia.**

110.20 metres **A weakly foliated, variably carbonatized, autolith bearing, silicified serpentinized olivine macrocryst/microcryst/macrocryst fragment-rich, crystallinoclastic, diatreme facies kimberlite lithic breccia, with an extensively kelyphitized garnet macrocryst.**

137.46 Metre Interval

137.46 metres **A weakly pyritic, fine grained, calcareous arenaceous mudstone, with included pebbles of limestone and calcareous shale and mudstone.**

PETROGRAPHIC DESCRIPTIONS

Bonus Pipe--Thin Sections from Hand Samples from Blasted Trench

#1 (oversize) This sample is dominated by a 3 x 4cm rounded, concentrically layered, autolith cored by a 1 x 2cm altered nodule of probable wehrlite. Several small non-layered autoliths also are present and these appear to reflect at least two separate populations. Several intensely altered, subangular fragments of crustal wallrock also are present. Macrocrysts and microcrysts of serpentinized olivine are very abundant, and phlogopite xenocrysts are relatively common in both host kimberlite and autoliths. Spinel microcrysts also are relatively common in both host kimberlite and autoliths, and several macrocrysts were observed. The spinel xenocrysts range from pale brown to deep reddish brown to black, and generally have thin opaque rims of probable titanomagnetite. Ilmenite microcrysts are present but are less abundant than spinel. These typically are rimmed by granular aggregates of titanomagnetite(?), perovskite +/- rutile and/or anatase and/or titanite. A single unusual subrounded, irregular, 1 x 1.6mm, phlogopite-rich xenolith(?) was noted. This xenolith(?) is dominated by a group of coarse calcite pools that are surrounded and invaded by relatively coarse (as much as 0.1 x 0.4 mm) phlogopite laths. Pool areas are also surrounded by abundant opaque oxide grains (average size ~ 0.03mm) and altered perovskite. The overall pool area is bounded by a mixture of blocky, fine grained calcite and serpentine with variable amounts of opaque oxides and perovskite. This pool area is completely different from other segregationary pools in either the host kimberlite or autoliths in this thin section.

The host kimberlite is characterized by moderately abundant macrocrysts and very abundant microcrysts of serpentinized olivine, set in a finely crystalline groundmass of roughly equant, blocky crystals of serpentine and calcite, with abundant opaque oxide grains and variably altered perovskite. In addition, irregular pools of coarse calcite and/or optically contiguous, very pale green serpentine (serpophite?), are abundant. Pools may consist entirely of contiguous and or locally recrystallized serpentine, but typically, carbonate borders and/or penetrates into serpentine pools and commonly is the sole occupant of pools. The subhedral to nearly euhedral nature of much of the groundmass serpentine infers replacement of abundant primary microphenocrystic olivine. This serpentine is locally replaced by calcite that has preserved the original texture. Many opaque oxide mineral grains and perovskite occur as necklaces on serpentinized olivine macrocrysts and microcrysts. Small grains of spinel are very abundant in the host kimberlite and small autoliths. Perovskite is moderately abundant in both autoliths and host kimberlite, and most is partially to completely altered to mixtures of kassite [$CaTi_2O_4(OH)_2$], anatase and titanite (sphene). Small equant grains to irregular masses of pyrrhotite(?) commonly occur within serpentinized olivine macrocrysts and microcrysts. Millerite occurs as fine needles in many serpentinized olivine macrocrysts, especially those within autoliths.

Most of the small autoliths in this sample commonly are cored by serpentinized olivine macrocrysts and are very similar texturally and mineralogically to the host kimberlite except for a general lack of pool calcite and serpentine. These autoliths dominate the overall autolith population, appear to be the youngest autoliths, and are referred to as Type 1 autoliths. They might best be described as **weakly carbonatized, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite.** One small autolith (~ 2.4 x 3.6mm) is highly enriched in phlogopite (> 10%), opaque minerals and altered perovskite, and contains a few irregular segregationary pools of calcite +/- serpentine. Although the matrix consists primarily of a fine grained mixture of serpentine and carbonate, it is not dominated by serpentinized olivine microphenocryst pseudomorphs. Most of the carbonate, other than that in pools, in this autolith appears to be secondary. This autolith clearly reflects a different melt phase than the other autoliths and is referred to as Type 3. It might best be referred to as **a weakly carbonatized, macrocrystic, hypabyssal, perovskite opaque mineral-rich, calcite phlogopite serpentine kimberlite with minor segregationary texture**.

The large rounded, concentrically layered, cored autolith (nucleated accretionary autolith?) that dominates this thin section is quite spectacular. Its composition is very similar to most of the smaller autoliths in the sample, but it appears to be somewhat more enriched in serpentinized olivine microcrysts, opaque minerals, and perovskite. It also is more enriched in calcite +/- serpentine segregationary pools, and locally, microcrysts and small macrocrysts of phlogopite, spinel and ilmenite, as well as groundmass phlogopite. The most prominent feature of this autolith, other than its peridotite core, is its concentrically layered texture. The layers range from a few hundred microns to several millimetres in width and are defined by variable concentrations of serpentinized olivine macrocrysts and microcrysts, phlogopite xenocrysts, opaque minerals and perovskite, and segregationary pools of calcite +/- serpentine. A prominent feature within the concentric layers is the parallel to subparallel alignment of most elongate mineral grains. The groundmass matrix in the various layers is essentially similar, and is similar to that in most of the smaller autoliths and the host kimberlite. This large autolith is similar to features referred to as nucleated autoliths by Ferguson et al. (1973) and Danchin et al. (1975), and which are considered by the latter authors to have developed by magmatic crystallization about nucleating centers. Rounded cored autoliths of this type (either with or without concentric layering) in hypabyssal kimberlite are currently generally referred to as globular segregations (e.g., Clement, 1982; Mitchell, 1986). Those with concentric layering might be considered accretionary. This cored or nucleated autolith or cored globular segregation as it might be called is referred to as a Type 2 autolith and is composed of **weakly carbonatized, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with local segregationary texture.**

The coarsely granular xenolithic core to the nucleated autolith is intensely altered and locally replaced carbonate and fine grained secondary minerals of questionable composition. However, based on textural relationships of the serpentine that has replaced the majority of the grains, olivine was the predominant component of this nodule. The only other significant primary mineral constituent of this nodule also has been completely altered and replaced by a mixture of probable tremolitic amphibole, carbonate, phlogopite, serpentine, and rutile. The primary mineral phase likely was diopside, but several smaller grains that are primarily carbonatized may have been enstatite. Consequently, the core nodule is tentatively classified as a **wehrlite.**

This entire sample might best be referred to as **a nucleated (or accretionary) autolith (or globular segregation) dominated, weakly carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with segregationary texture.**

<u>#2 (oversize)</u> This sample is very similar texturally and mineralogically to sample #1, although portions of two "accretionary" autoliths (rounded autoliths with concentric layering and aligned xenocrysts) are present (one ~ 2.4mm across and one ~ 2mm across). These probably reflect cuts in the outer regions of cored or nucleated autoliths (Type 2 autoliths) similar to that in thin section #1. Smaller autoliths (Type 1) also are present and these are non-layered, typically cored by serpentinized olivine macrocrysts (one 6mm long), and in general, compositionally similar to their "accretionary" neighbors. However, an irregular autolith ~ 2cm across present at one edge of the slide is quite different from the other autoliths. This autolith is extensively carbonatized, contains several angular fragments of intensely altered and carbonatized wallrock material, has a much lower opaque mineral-perovskite content, and the groundmass contains significantly fewer carbonatized, serpentinized pseudomorphs of microphenocrystic olivine. The groundmass consists primarily of very fine grained crystals of serpentine, at least half of which are replaced by carbonate. There is no evidence for any primary carbonate, but significant concentrations of variably altered to completely carbonatized laths of phlogopite are present and appear to be a groundmass

phase. This autolith is referred to as a Type 4A and might best be described as an **extensively carbonatized, macrocrystic, hypabyssal, perovskite opaque mineral and phlogopite- bearing, serpentine kimberlite, with intensely altered wallrock xenoliths.**

As with sample #1, this entire sample might best be referred to as a **nucleated (or accretionary) autolith (or globular segregation) dominated, weakly carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with segregationary texture.**

<u>#4 (oversize)</u> This is an autolithic kimberlite that is very similar to samples #1 and 2, but contains a population of at least four different types of autoliths that reflect different melts and melt conditions. Most common are Type 1 autoliths that are moderately small (~ 1-4mm), rounded to subrounded features, most of which are cored by serpentinized olivine macrocrysts. Some lack cores and others are cored by phlogopite or spinel macrocrysts, or intensely altered and carbonatized wallrock fragments. These autoliths are all macrocrystic, opaque mineral-perovskite-rich, and contain little to no pool carbonate or serpentine. They are compositionally similar to the larger, concentrically layered and elongate mineral aligned "accretionary" Type 2 autoliths, except the latter generally are somewhat more enriched in opaque minerals, perovskite and phlogopite, and typically contain some layers with relatively abundant irregular pools of calcite and/or serpentine. The third type of autolith is characteristically enriched in phlogopite, opaque minerals and perovskite. Only a single example of this autolith type was observed (2.4 x 4.0mm). It is identical to an autolith present in sample #2 that was referred to as Type 3 and described as **a weakly carbonatized, macrocrystic, hypabyssal, perovskite opaque mineral-rich, calcite phlogopite serpentine kimberlite with minor segregationary texture**. The fourth type of autolith is characterized by relatively extensive carbonatization, low opaque mineral-perovskite content, lower concentration of serpentinized olivine macrocrysts and microcrysts, and the groundmass contains fewer carbonatized, serpentinized pseudomorphs of microphenocrystic olivine. Intensely altered and carbonatized, angular fragments of wallrock material are present locally. The groundmass consists primarily of very fine grained crystals of serpentine, at least half of which are replaced by carbonate. Laths of probable groundmass phlogopite are relatively common, and these locally are partially replaced by chlorite and/or carbonate. Minor irregular small pools of serpentine and/or carbonate also are present. Pool serpentine commonly is recrystallized to very fine grained aggregates. This autolith is a Type 4 A variety and might best be described as an **extensively carbonatized, weakly macrocrystic, hypabyssal, perovskite, opaque mineral and phlogopite-bearing, serpentine kimberlite, with relict segregationary texture.**

This entire sample might best be referred to as a **weakly carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with segregationary texture and multiple generations of autoliths (at least 4).**

<u>#6 (oversize)</u> This sample is very similar to the previously described Bonus samples, and is characterized by a very high content of autoliths (at least 50% of the thin section

volume) that range from < 1.0 to nearly 2cm. Most autoliths are of the Type 1 and Type 2 variety and commonly are cored by serpentinized olivine macrocrysts or intensely altered wallrock fragments. They are characterized by relatively abundant opaque oxides and perovskite, very fine grained groundmass composed primarily of calcite pseudomorphs after microphenocrysts and tiny microcrysts of serpentinized olivine and variable amounts of microcrystalline serpentine. The principal distinction of the Type 2 accretionary autoliths is that they tend to exhibit a crude to well developed segregationary layering commonly defined by zones enriched in carbonate and/or serpentine pools and have elongate minerals commonly aligned parallel to autolith boundaries. Although the opaque oxide/perovskite content of the two autolith types tends to be fairly consistent, the accretionary autoliths tend to have somewhat higher ratios of perovskite to spinel and commonly higher total concentrations. Several Type 3 autoliths also are present, and typically are characterized by high phlogopite, opaque oxide and perovskite content. A possible Type 3 autolith variant occurs as a core in a Type 1 autolith. This core autolith (referred to as Type 3A) is about 1.8mm long and is characterized by high phlogopite content (coarser than in typical Type 3 kimberlite), moderate amounts of opaque oxide/perovskite, non-carbonatized serpentinized olivine microcrysts, and a groundmass that is essentially all carbonate. The largest autolith in this sample is a subangular, embayed clast about 2cm across that is characterized by a low content of serpentinized olivine macrocrysts and large microcrysts, low opaque oxide/perovskite content, near exclusion of segregationary pools, and extensive carbonatization. Partially to completely carbonatized small microcrysts (< 0.3mm) of serpentinized olivine are very abundant, and these are set in a dusky matrix of carbonate and variable amounts of microcrystalline to cryptocrystalline serpentine. This autolith (referred to as Type 4) is compositionally somewhat comparable to the Type 4 A autoliths described in Sample #4, but the latter lack abundant small altered olivine microcrysts and are characterized by prominent carbonatized laths of groundmass phlogopite. The Type 4 autolith kimberlite might best be described as **extensively carbonatized, weakly macrocrystic strongly microcrystic, hypabyssal, perovskite, opaque mineral and phlogopite-bearing, serpentine kimberlite, with minor segregationary texture.**

A Type 3 autolith variant (Type 3A) is included within the large Type 4 autolith. This autolith is subrounded, about 3mm long, is moderately phlogopite rich but has a lower content of opaque oxide/perovskite than Types 1, 2, and 3 but higher than 4. It also has a higher content of serpentinized olivine macrocrysts and large microcrysts, and contains a few small segregationary pools of carbonate/serpentine. The matrix is mostly microcrystalline carbonate, much of which is replacing microphenocrysts and tiny microcrysts of serpentinized olivine. It might best be referred to as a **weakly carbonatized, macrocrystic, hypabyssal, perovskite/opaque mineral bearing, phlogopite calcite serpentine kimberlite.**

The overall sample is designated as a **weakly carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with segregationary texture and multiple generations of autoliths (at least 4).**

#7 (oversize) This sample is very similar to Sample #6, and also is dominated by autoliths (about 50% of the total volume). Type 1 autoliths are most abundant and these are both cored and non-cored. At least four accretionary autoliths or globular segregations (Type 2) are present, and three of these are composite autoliths with two generations of kimberlite mantling a core clast. Two of these composite autoliths are cored by macrocrysts of serpentinized olivine. The third and largest autolith (~ 3cm long) in this sample is cored by a nearly completely carbonatized clast of what may have been a leucogabbro. This autolith (like the other composite autoliths) has a thin inner mantle (as much as 3.6mm wide locally) of kimberlite that is enriched in fine grained phlogopite, has a lower opaque mineral/perovskite content and is less carbonatized than the thicker outer mantle that is compositionally typical of Type 1 autolith kimberlite. The inner layer kimberlite also appears to have a higher ratio of perovskite to spinel, more groundmass serpentine, and phlogopite crystals commonly are partially to completely chloritized. This appears to be a variety of Type 3 autolith (Type 3A) and can be referred to as **weakly carbonatized, macrocrystic, hypabyssal, perovskite/opaque mineral bearing, phlogopite calcite serpentine kimberlite.**

The rest of this sample is essentially the same as Sample #4 and is best described as a **weakly carbonatized, autolithic (accretionary or globular segregation dominated), macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with segregationary texture and multiple generation autoliths, including composite autoliths.**

#8 (oversize) This sample has a very pronounced macrocrystic/microcrystic texture and segregationary pools of calcite and serpentine are very abundant. Central pool areas typically are filled with clear to very pale green, optically contiguous serpentine (serpophite) partially to completely surrounded by calcite. Prismatic crystals of calcite commonly invade the pool serpentine from pool margins. The autolith content is appreciably lower than in previous samples, accounting for less than 30% of the slide volume. Several intensely altered wallrock fragments are present, and these commonly are mantled by Type 1 autolithic kimberlite. Type 1 autoliths are most abundant, but both Type 3 and 3A phlogopite rich varieties are relatively common. All types occur as both cored and non-cored, but those mantling serpentinized olivine macrocrysts are most common. This sample is best designated as a **weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture.**

#9 (oversize) This sample is very similar to Sample #8 in having very pronounced macrocrystic/microcrystic and segregationary textures. Autoliths comprise less than 30% of the thin section volume and these are primarily Type 1 and Type 3 and 3A. Most are cored by serpentinized olivine macrocrysts and intensely altered wallrock material, but many are non-cored and several are cored by phlogopite macrocrysts. This sample has been flooded locally by Fe rich solutions that deposited dark reddish brown to brown black Fe oxyhydroxides. As with Sample #8, this sample is designated a **weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal,**

perovskite and phlogopite-bearing, opaque mineral-rich, calcite, serpentine kimberlite with pronounced segregationary texture.

#10 (oversize) This sample is nearly identical to Sample #9 and is similarly designated as a **weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite, serpentine kimberlite with pronounced segregationary texture**.

#12 (oversize) This sample is somewhat similar to Sample #8 but is slightly more enriched in autoliths, and some of these are more complex. Autoliths are cored primarily by serpentinized olivine macrocrysts or are non-cored, but some have cores of intensely altered wallrock material. Several composite autoliths are present and these typically are composed of an inner mantle of phlogopite and opaque oxide/perovskite rich Type 3 kimberlite overgrown or partially overgrown by less phlogopite rich and opaque oxide/perovskite poor Type 3A kimberlite. A few other composite autoliths have an outer mantle of Type 1 hypabyssal kimberlite rimming Type 3 kimberlite. The multiple phase history of the Bonus pipe kimberlite melt is well expressed in this thin section. This sample might best be designated a **weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture and multiple composite autoliths.**

#13 (oversize) This sample has very pronounced macrocrystic/microcrystic and segregationary textures. It has a moderately abundant autolith population (~ 30% of the thin section volume) that is dominated by Type 1 autoliths that are both cored and non-cored. Several autoliths, including the largest (~ 8mm across) in the sample, exhibit very crude segregationary layering defined in part by small pools of calcite and serpentine, and these are probably Type 2 accretionary autoliths or globular segregations. Several microcrysts and small macrocrysts (up to 0.55mm) of spinel are present, and range from nearly opaque grains to orange brown grains rimmed by opaque titanomagnetite. The sample has been invaded by relatively abundant Fe oxyhydroxides. It is very similar to most of the previously described Bonus pipe samples and is best referred to as a **weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture.**

#14 (oversize) This sample is similar to the previous sample in having very prominent macrocrystic/microcrystic and segregationary textures, and containing about 30-35% included autoliths. Most of the autoliths are Type 1 kimberlite and are either non-cored or cored by serpentinized olivine macrocrysts or intensely altered wallrock fragments. However, one small autolith about 2.2mm long is composed of Type 3A kimberlite (moderate phlogopite and opaque oxide/perovskite content) cored by a subrounded autolith of intensely carbonatized, moderately phlogopite rich and opaque oxide/perovskite poor Type 4 kimberlite. The matrix of this core autolith consists primarily of microcrystalline carbonate, and phlogopite typically is partially to completely chloritized and partially carbonatized. This overall sample might best be referred to as a **weakly to moderately carbonatized, autolithic, prominently**

macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture.

#15 (oversize) This sample is very similar to Sample #14 in having very pronounced macrocrystic/microcrystic and segregationary textures, but has a higher content of autoliths (~ 35-40%). Type 1 autoliths dominate and most are either non-cored or cored by serpentinized serpentine macrocrysts, phlogopite macrocrysts (as much as 1.3mm long) or intensely altered wallrock material. However, several Type 1 autoliths are cored by Type 3A moderately phlogopite rich, opaque oxide/perovskite poor kimberlite. Autoliths of phlogopite and opaque oxide/perovskite rich Type 3 kimberlite also are present, and some of these have overgrowths of Type 3A kimberlite. A moderately large autolith (~ 1cm across) of a Type 4 variant kimberlite (Type 4A) is partially rimmed by Type 3A kimberlite. This autolith contains a greater proportion of macrocrysts and large microcrysts of serpentinized olivine than typical Type 4 kimberlite, and is considerable less carbonatized although macrocrysts and microcrysts are mostly replaced by carbonate. However, significant amounts of microcrystalline serpentine are present in the groundmass along with the typically abundant carbonate. Phlogopite is somewhat less abundant than in most Type 4 autoliths, and most is partially choritized and partially to completely replaced by carbonate. This sample might best be called a **weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture and multiple generation composite autoliths.**

#16 (oversize) This sample is quite similar to Sample #15 in having very pronounced macrocrystic/microcrystic and segregationary textures, but about 50% of the thin section volume is comprised by autolithic material. Type 1 kimberlite autoliths predominate and these are both non-cored and cored primarily by serpentinized olivine macrocrysts, phlogopite macrocrysts and microcrysts, and to a lesser degree by intensely altered wallrock fragments and rarely, Type 3 phlogopite-opaque-oxide-perovskite-rich kimberlite. A single autolith cored by a large macrocryst of mostly carbonatized serpentinized olivine is characterized by very high opaque mineral/perovskite content (as much as 10-20 %) and small to moderate numbers of serpentinized olivine microcrysts. Smaller microcrysts are completely carbonatized, but the larger microcrysts exhibit only partial replacement by carbonate. Microcrysts typically are necklaced by opaque oxides and perovskite as are those in host kimberlite. The groundmass of this autolith is characteristically very fine grained and dominated by carbonate, much of which appears to be pseudomorphic after microphenocrysts and tiny microcrysts of serpentinized olivine. These grains are set in mesostasis of microcrystalline to cryptocrystalline serpentine and carbonate and tiny laths of phlogopite also are present. Except for the exceptionally high opaque oxide/perovskite content of this kimberlite, it is very similar to that of Type 1 autoliths and host kimberlite. Consequently, it is referred to as Type 1A kimberlite and described as a **weakly carbonatized, macrocrystic, hypabyssal, phlogopite-bearing, perovskite opaque mineral calcite serpentine kimberlite.**

Several autoliths of a possible Type 4 variant are present and these typically include small autoliths of Type 3A kimberlite material, and are in part rimmed by apparent Type

3A kimberlite. This variant has a slightly greater concentration of macrocrysts and large microcrysts than normal Type 3 kimberlite, but they are similarly extensively replaced by carbonate. However, the groundmass is considerably less carbonatized and microcrystalline serpentine is very abundant (as much as 50% of the mesostasis). Some of the groundmass serpentine appears to reflect pool material that has been partially to completely recrystallized and partially replaced by carbonate. Phlogopite tends to be less abundant, but is similarly partially chloritized and partially to completely carbonatized. Opaque oxides and perovskite are moderately abundant, and commonly necklace macrocrysts and larger microcrysts of serpentinized olivine. These autoliths are referred to as Type 4A and may be described as **carbonatized, moderately macrocrystic, hypabyssal, perovskite, opaque mineral and phlogopite-bearing, serpentine kimberlite, with minor segregationary texture.** The 4A autoliths appear to have a comparable time history as 3A autoliths in that they both include and are partially rimmed by 3A kimberlite.

Microcrysts (up to 0.4mm long) of pale brown to orange and reddish brown spinel are relatively common in this sample. Most of these spinel grains are rimmed by opaque titanomagnetite. As with many other Bonus pipe samples, this sample is characterized by abundant autoliths of multiple generations and may be referred to as a **moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture and multiple generation composite autoliths.**

#17 (standard size) This is a very typical Bonus pipe sample being characterized by very prominent macrocrystic and segregationary textures and an abundance of well rounded autoliths that comprise in excess of 40% of the thin section volume. The autolith population is dominated by Type 1 kimberlite that is similar to host material but contains only minor, small segregationary pools of serpentine and calcite. These autoliths typically are cored by serpentinized olivine macrocrysts, intensely altered wallrock fragments (especially carbonates), or minor phlogopite macrocrysts, but many are non-cored. Several small autoliths of moderately carbonatized Type 4A kimberlite also are present. A single macrocryst (0.61mm long) of very pale brown spinel and several microcrysts of reddish brown to orange brown spinel, all rimmed by opaque titanomagnetite, also were observed. This sample might best be designated a **weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture.**

#18 (standard size) This sample has very prominent macrocrystic and segregationary textures and contains abundant autoliths (> 40% of total thin section volume). As with previous samples, Type 1 autoliths predominate and most are either non-cored or cored by serpentinized olivine macrocrysts. Several are cored by phlogopite macrocrysts and a few have cores of intensely altered wallrock fragments that appear to be choritized and carbonatized, titanite (formerly ilmenite?) bearing diorite (?). One large autolith (~ 1.5cm across) exhibits a crude alignment of elongate mineral clasts and concentric zonation of small segregationary pools and is likely a Type 2 accretionary autolith (globular segregation). Several irregular autoliths of Type 4A kimberlite are partially rimmed by very microcryst rich strongly carbonatized Type 4 kimberlite, which in turn is rimmed by Type 1 kimberlite. One Type 4A autolith (~ 8.8mm across) contains an elongate subrounded autolith (~1.6 mm long) of Type 4 kimberlite. This sample might best be designated a **moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, and several multiple generation composite autoliths.**

#20 (oversize) This sample is dominated by two accretionary autoliths (Type 2), one of which occupies more than 50% of the thin section. As with previous samples, the host kimberlite has very pronounced macrocrystic and segregationary textures and contains abundant small autoliths, both cored and non-cored, of Type 1 kimberlite. Type 3 autoliths are present as isolated features, as overgrowths on intensely altered diorite (?) fragments, and included in the large accretionary autolith and in a Type 4A autolith. The two accretionary autoliths in this sample are 4cm and 1.5cm across respectively. Both exhibit reasonably strong concentric segregationary features and crude alignment of elongate mineral clasts. A locally pronounced layering is imparted by concentrations of macrocrysts and microcrysts of serpentinized olivine, opaque minerals and perovskite, and/or small segregationary pools of calcite and serpentine. The largest Type 2 autolith also has a thin (~ 2mm thick) outer layer that is darker and finer grained than the bulk of the autolith. These autoliths are compositionally quite similar to host kimberlite and Type 1 autoliths, but tend to be somewhat more enriched in phlogopite, and contain appreciably more segregationary calcite and serpentine than Type 1 autoliths. The large accretionary autolith (or nucleated autolith) is cored by a 2.4cm long altered nodule of peridotite. Olivine grains are completely serpentinized and replaced locally by calcite. Clinopyroxene (diopside?) comprised about 20% of the nodule, but is almost entirely replaced by intergrown mixtures of phlogopite, chlorite, amphibole, rutile, talc (?), and minor calcite and quartz. Orthopyroxene also apparently was present (~ 5% of total nodule) but is completely replaced by calcite and serpentine with minor phlogopite. Several irregular grains of chromite (?) as much as 0.9mm long also are present. The nodule is an altered spinel lherzolite of probable uppermost mantle origin. This rock might best be termed a **moderately carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with segregationary texture, multiple generation autoliths, and a spinel lherzolite nodule coring an accretionary or nucleated autolith (globular segregation).**

#21 (oversize) This sample is nearly identical with Sample #20 except it lacks Type 3 and multiple generation autoliths, and contains two subangular xenoliths of wallrock carbonate. The large nucleated accretionary autolith with spinel lherzolite core comprising about 60% of the thin section. It is referred to as a **moderately carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with segregationary texture, and a spinel lherzolite nodule coring a nucleated accretionary autolith (globular segregation).**

#22 (oversize) This thin section cuts the same nucleated accretionary autolith as the previous two sections, and the autolith comprises nearly 70% of the total volume. However, less of the core peridotite nodule is present, and clinopyroxene along one margin of the nodule is replaced by much coarser granular aggregates of phlogopite, talc, calcite and quartz with minor rutile. Also prominent in this sample is a 1.3cm xenolith of partially carbonatized weakly sericitized shale with a thin mantle (up to 2mm) of Type 4A autolithic kimberlite. It should be assigned the same rock name as the previous sample; **moderately carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with segregationary texture, and a spinel lherzolite nodule coring a nucleated accretionary autolith (globular segregation).**

#23 (oversize) This sample also cuts the same nucleated accretionary autolith as the previous three samples, but the cut is further from the center of the core nodule. Consequently, only about 6mm of peridotite are included in this section although the autolith is about 3.5cm across. However, because of the changing cut angle as the margin of the autolith is approached, the darker, finer grained outer layer of the accretionary feature has increased to nearly 5mm in thickness. This autolith comprises about 50% of the thin section volume. Small autoliths of Type 1 kimberlite are abundant throughout the rest of the thin section, but several larger autoliths (up to 7.2mm) of Type 4A kimberlite are present. One of the 4A autoliths includes an autolith of phlogopite rich Type 3 kimberlite and a small autolith (~ 1mm in diameter) of Type 3 kimberlite is overgrown by a Type 1 autolith. The host kimberlite is the same as that in previously described samples. This rock is best referred to as a **moderately carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with segregationary texture, multiple generation autoliths, and a spinel lherzolite nodule coring a nucleated accretionary autolith (globular segregation).**

#24 (oversize) This sample is quite similar to many previous samples in having very pronounced macrocrystic/microcrystic and segregationary textures. Autoliths comprise about 40% of the thin section volume and these are primarily Type 1 although Types 3, 4 and 4A are present. Most are cored by serpentinized olivine macrocrysts and intensely altered wallrock material, but many are non-cored, several are cored by phlogopite macrocrysts, and one is cored by a Type 4 autolith. The largest autolith in the sample is about 1cm across, very well rounded, and appears to have a weak concentric segregation of coarse versus fine mineral clasts. It is probably an accretionary Type 2 autolith, and may reflect a cut near the outer edge of the nucleated accretionary autolith that dominates the previous four thin sections (#s 20, 21, 22 and 23). This sample has been flooded locally by Fe rich solutions that deposited dark reddish brown to brown black Fe oxyhydroxides. The sample is designated a **weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, and multiple generation autoliths.**

#25 (oversize) This sample also is characterized by prominent macrocrystic and segregationary textures as well as a very high content of autoliths (> 50% of total thin section volume). The autolith population is dominated by relatively small (most < 2mm in diameter) Type 1 autoliths that are either non-cored or cored by macrocrysts of serpentinized olivine or, locally, by phlogopite macrocrysts. However, some of these Type 1 autoliths range up to nearly a centimetre in diameter and these typically are cored by intensely altered, angular to subrounded, sedimentary wallrock fragments, although one is cored by 7mm long macrocryst of serpentinized olivine. Next most abundant are Type 4 autoliths that typically are subangular to subrounded and range up to 1.8cm. Several of the Type 4A autoliths contain small, included autoliths of Type 3A kimberlite. Two non-cored, accretionary Type 2 autoliths (~ 1.2cm and 8 mm in diameter) also are present. Both exhibit relatively pronounced concentric segregationary layering, and the larger of the two is rimmed by a thin overgrowth (as much as 1.2mm thick) of light coloured, segregationary pool deficient Type 1 autolith kimberlite. Pale orange brown to reddish brown spinel microcrysts (up to 0.5mm) rimmed by titanomagnetite are relatively common in both Type 1 and 2 autoliths as well as the host kimberlite. This sample is referred to as a **weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, multiple generation autoliths, and two globular segregation (accretionary) autoliths.**

<u>#26 (oversize)</u> This sample also is characterized by prominent macrocrystic and segregationary textures as well as containing an abundance of autoliths (about 50% of the total thin section volume). Type 1 cored and non-cored autoliths predominate and range to 1.2cm across. Most are cored by serpentinized olivine macrocrysts (one nearly 1cm long, partially replaced by calcite and with several grains of millerite and pyrrhotite (?) and a single grain of unaltered diopside), but intensely altered clasts of wallrock sediments also serve as cores. As with Sample #25, the second most dominant autolith type is 4A. These tend to be small (< 2.5mm) and commonly core Type 1 autoliths, although one Type 4A autolith is nearly 1.2cm long. Type 3A kimberlite occurs both as autoliths with intensely altered sedimentary wallrock clast cores and as inclusions in Type 4A autoliths. Only a single small autolith (~ 1.6mm long) of phlogopite rich Type 3 kimberlite was observed as well as one Type 2 accretionary autolith about 6.4mm in diameter. Reddish brown spinel microcrysts rimmed by titanomagnetite are relatively common, and one irregular grain about 0.45mm long has a titanomagnetite rim about 0.2mm thick and cores a small Type 1 autolith. This sample is quite similar to Sample #25 and may be referred to as a **weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, multiple generation autoliths, and one globular segregation (accretionary) autolith.**

<u>#27 (oversize)</u> This sample is similar to many of the previously described samples in having very pronounced macrocrystic and segregationary textures and containing very abundant autoliths (40-50%). Type 1 autoliths dominate, but subangular to subrounded Type 4A autoliths also are relatively abundant. The largest autoliths in the sample are of the Type 2 accretionary variety, and these range from 8mm to 1.3cm across. These exhibit moderately well developed concentric segregationary layering, and two of the three present are cored. The largest is cored by a subrounded autolith (1.6mm long) of phlogopite, serpentinized olivine macrocryst rich Type 3 kimberlite, in which much of

the phlogopite is partially to completely chloritized. The intermediate sized accretionary autolith is a nucleated feature with an intensely altered spinel harzburgite (?) core. All olivine and apparent orthopyroxene are completely replaced by serpentine. However, faint relict cleavage appears to be preserved in the pyroxene grains that also typically contain a much higher percentage of matted dusky mixtures of talc as well as a much higher secondary opaque mineral content (very fine grained magnetite? with larger crystals of pyrite?). Pale brown spinel occurs as irregular intergranular crystals as much as 0.8mm long. Several additional Type 3 autoliths also are present and range up to 2.8mm in length. Titanomagnetite rimmed, pale brown to reddish brown spinel xenocrysts (as much as 0.85mm across) are relatively common in this sample. A few embayed microcrysts of ilmenite with granular rims of titanomagnetite and perovskite (?) crystals also are present. This sample is designated as a **weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, multiple generation autoliths, and three globular segregation (accretionary) autoliths (one with a spinel harzburgite? core).**

#28 (oversize) This sample has very pronounced macrocrystic and segregationary textures and is dominated by autoliths (~ 40-50% by volume). Most abundant autoliths are of the Type 1 variety that are cored by serpentinized olivine macrocrysts, phlogopite macrocrysts, intensely altered wallrock fragments, or are non-cored. A single small, opaque oxide/perovskite rich Type 1A autolith also was observed. Second most abundant are Type 4A autoliths. These are typically subrounded and small, but a 1.1cm autolith is intergrown with Type 4A kimberlite and includes two autoliths of phlogopite rich Type 3 kimberlite that are more than 3mm long. The phlogopite in one of the included Type 3 autoliths is extensively chloritized. An isolated Type 3 autolith also was observed. A single 1.2cm long accretionary nucleated autolith (Type 2) is cored with a 1cm long nodule of altered spinel lherzolite. Several grains of only slightly amphibolitized and chloritized diopside are preserved, but all olivine and orthopyroxene crystals are entirely replaced by secondary products (mostly serpentine). Irregular grains of reddish to dark orange brown spinel are confined mostly to areas of diopside, and one of these crystals is more than 1.3mm long. The mantling Type 2 kimberlite exhibits moderate alignment of mineral clasts, and a 0.1-0.3mm wide zone bordering the core peridotite nodule is much finer grained. Narrow elongate pools of predominantly carbonate also are present. Xenocrysts of pale brown to reddish brown spinel rimmed by titanomagnetite are relatively abundant and range up to 0.8mm across. The sample is best classified as a **weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, multiple generation autoliths, and a single nucleated accretionary autolith (globular segregation) with a spinel lherzolite core.**

#29 (oversize) This sample is very similar to Sample #28 but it slices a 2.3cm portion of a nucleated accretionary autolith (Type 2) and the piece of preserved core peridotite is nearly 2cm across. The autolith kimberlite exhibits moderately well developed segregationary layering and alignment of elongate mineral clasts is significant. Although the peridotite nodule is intensely altered, the three primary silicate mineral phases, olivine, orthopyroxene and diopside, can be determined on the basis of textures and alteration products. Olivine is completely serpentinized and contains minor amounts of carbonate and tiny fibers of talc (?). Orthopyroxene (enstatite) also is extensively serpentinized but contains fibrous anthophyllite as well as talc and carbonate. Diopside appears to be replaced primarily by fine prisms of anthophyllite and tremolite with minor phlogopite, chlorite and rutile. Irregular crystals (as much as 1.3mm long) of pale brown spinel occupy intergrain areas in this spinel lherzolite. Several small (most < 2mm) Type 4A autoliths are present, and a single 1.2mm phlogopite rich Type 3 autolith was observed. As with the previous sample, this sample is described as a **weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, multiple generation autoliths, and a single nucleated accretionary autolith (globular segregation) with a spinel lherzolite core.**

#30 (oversize) This sample is similar to the immediately previous samples but has three accretionary autoliths, two of which are nucleated with intensely altered peridotite nodule cores. The concentric segregationary layering in these autoliths is poorly developed but nevertheless is evident. Furthermore, all have small, generally elongate pools of carbonate with minor serpentine. The two altered core nodules are 5mm and 2.5mm across and appear to be lherzolitic in composition. Several small Type 4A autoliths (most < 4mm) are present, and a single small (1.1mm), phlogopite rich Type 3 autolith was observed. Many of the predominant Type 1 autoliths are cored by intensely altered wallrock sediments and extensively choritized and carbonatized diorite (?). In addition to the most common serpentinized olivine macrocryst cores, many Type 1 autoliths are cored by phlogopite macrocrysts, some as much as 5.25mm long. This sample might best be called a **weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, multiple generation autoliths, and two nucleated accretionary autoliths (globular segregations) with spinel lherzolite cores.**

#31 (oversize) This thin section is similar in most respects to the previous samples, but is dominated by a subrounded 2cm Type 4 autolith with many well rounded, phlogopite rich Type 3 autoliths (1-4mm across) and a few subangular to subrounded Type 4A autoliths and several intensely altered fragments of wallrock sediments and possible chloritized and carbonatized diorite. This Type 4 autolith is characteristically enriched in small microcrysts (< 0.3mm) of serpentinized olivine that are extensively replaced by carbonate and locally by fibrous talc. Small Type 4A and Type 3 autoliths also occur within the host kimberlite, the former commonly with intensely altered diorite (?) cores, and the latter typically with extensively chloritized phlogopite. This sample is referred to as a **weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture and multiple generation autoliths.**

#32 (oversize) This thin section is dominated by Type 2 accretionary autoliths that occupy greater than 50% of its volume. Portions of two small (~ 1 cm across) non-cored autoliths occur at the edge of the section, and nearly half of the section is covered by a 3cm portion of a nucleated accretionary autolith with a large (~ 2.5cm long) altered peridotite core. All of the autoliths exhibit moderately well developed concentric segregationary layers defined by grain size differences and, locally, presence of elongate pools of calcite +/-serpentine. The autolith is characterized by weakly to moderately well aligned serpentinized olivine macrocrysts and microcrysts set in crudely concentric layers defined by higher concentrations of macrocrysts and microcrysts. Autolith composition appears to be very similar to that of the host kimberlite except for a lack of significant pool calcite in the autolith matrix. This large autolith and smaller cored autoliths in the sample are similar to features referred to as nucleated autoliths by Ferguson et al. (1973) and Danchin et al. (1975), and are considered by the latter authors to have developed by magmatic crystallization about nucleating centers. Rounded cored autoliths of this type (either with or without concentric layering) in hypabyssal kimberlite are currently generally referred to as globular segregations (e.g., Clement, 1982; Mitchell, 1986). Those with concentric layering might be considered accretionary.

Although the peridotite is intensely altered, all mineral phases can be identified based on textural features and alteration products. Altered olivine grains typically are pale yellow green and completely serpentinized, but they exhibit characteristic curviplanar fractures along which fibrous chrysotile is abundant whereas interior areas are replaced primarily by bladed antigorite. Serpentine has been replaced locally by calcite and minor amounts of fibrous talc. Orthopyroxene (enstatite) grains are nearly colourless, and altered almost entirely to bladed serpentine (antigorite +/- lizardite) that commonly preserves its host near right angle cleavage. Cleavage directions also are accentuated by the presence of tiny elongate grains of rutile. Clinopyroxene (diopside) is weakly pleochroic from very pale olive to pale olive, and typically is altered to fine prisms to blocky patchy areas of anthopyllite +/- tremolite. These prismatic minerals commonly intersect at approximately 56° and 124° angles, inferring that the clinopyroxene may have been replaced earlier by a more massive amphibole that was in turn replaced along cleavage traces by finer grained aggregates of acicular prismatic amphiboles. Amphibole cleavage traces also are inferred by the presence of minor secondary phlogopite and fine needles of rutile. Minor phlogopite along some grain boundaries, especially at multiple junctions is probably a product of introduced kimberlite fluid. Both phlogopite and amphibole are locally chloritized, especially along grain boundaries with olivine and enstatite. Irregular crystals of pale brown spinel are moderately abundant and range to as much as 5.4mm in length.

The remainder of the thin section is nearly identical to previously described sections in having very pronounced macrocrystic and segregationary textures and being comprised of about 40-50% autoliths. The autolith population is dominated by the Type 1 variety that typically are either non-cored or cored by serpentinized olivine macrocrysts, phlogopite macrocrysts, intensely altered wallrock fragments. Several small autoliths (most < 1.5mm) of Type 3, Type 4 and Type 4A also are present. This sample is described as a **weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich,**

calcite serpentine kimberlite with pronounced segregationary texture, multiple generation autoliths, and three nucleated accretionary autoliths (globular segregations), one with a spinel lherzolite core.

#33 (oversize) This sample is dominated by the same large nucleated accretionary autolith as in Sample #32, but considerably more of the feature is present. The autolith is about 4.6cm long and comprises nearly 2/3 of the thin section. The altered spinel lherzolite core nodule comprises about 80% of the autolith, and is transected longitudinally by several thin veinlets (most < 0.1mm wide) of calcite. The rest of the section is very similar to Sample #32, but contains no other accretionary autoliths. Type 1 autoliths dominate the autolith population, and only single autoliths of Type 1A, Type 3 and Type 3A were observed. The 1A autolith is about 2mm long and is cored by a serpentinized olivine macrocryst, and the 1.1mm long Type 3A autolith is cored by a 0.6mm reddish brown spinel xenocryst with a titanomagnetite rim. The Type 3 autolith is about 4.8mm across and is characterized by very abundant microcrysts (~0.05-0.20mm) of phlogopite as well as primary phlogopite laths in the groundmass. This sample is a **weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, multiple generation autoliths, and a single nucleated accretionary autoliths (globular segregations) with a spinel lherzolite core.**

#34 (standard size) This sample appears to be a slice through the same spinel lherzolite cored nucleated accretionary autolith described in Samples # 32 and #33. Approximately 40% of the thin section is covered by this accretionary autolith and the remainder of the sample is similar to the aforementioned samples. However, this sample contains a small non-cored Type 2 accretionary autolith (~ 3.6mm across), several small Type 4A autoliths (< 2.8mm across), and a single 1.4mm Type 3A autolith. Type 1 autoliths predominate in the sample and most are cored by serpentinized olivine macrocrysts. Phlogopite macrocrysts and microcrysts are common both as cores in Type 1 autoliths and in the host kimberlite. Spinel (chromite?) microcrysts and macrocrysts also are present in both Type 1 autoliths and host kimberlite, as are many opaque oxide mineral grains and perovskite that occur as necklaces on serpentinized olivine macrocrysts and microcrysts. Small grains of spinel are very abundant in the host kimberlite and small autoliths. Perovskite is moderately abundant in both autoliths and host kimberlite, and most is partially to completely altered to mixtures of kassite [$CaTi_2O_4(OH)_2$], anatase and titanite (sphene). Millerite occurs as fine needles in many serpentinized olivine macrocrysts, which are locally partially replaced by carbonate. Carbonate replacement is more extensive in autolith macrocrysts/microcrysts than in those in host kimberlite. The subhedral to nearly euhedral nature of much of the groundmass serpentine in both host kimberlite and autoliths infers replacement of abundant primary microphenocrystic olivine. This serpentine is locally replaced by calcite that has preserved the original texture. Local irregular pools of coarse carbonate (calcite) and lesser pools of serpentine are present in host kimberlite groundmass where some primary serpentine is locally replaced by calcite.

This sample is a **weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, multiple generation autoliths, and a single nucleated accretionary autoliths (globular segregations) with a spinel lherzolite core.**

#35 (standard size) This sample is essentially the same as Samples #34 except a larger piece (~ 2.8cm long) of the nucleated accretionary autolith is present. This autolith comprises about 75% of the thin section. Only Type 1 autoliths were observed in the remainder of the thin section, and these comprise about 40% of the kimberlite that hosts the accretionary autolith. This sample is a **weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, multiple generation autoliths, and a single nucleated accretionary autoliths (globular segregations) with a spinel lherzolite core.**

#36 (standard size) This sample cuts the same large nucleated accretionary autolith present in Samples #32-35. The autolith covers about 40% of the thin section and the peridotite nodule core is about the same size as that in Sample #34. Its host is similarly dominated by Type 1 autoliths, and single Type 4A (~ 2.4mm) and Type 3 (~0.7mm) autoliths were observed. This sample is a **weakly to moderately carbonatized, autolithic, prominently macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with pronounced segregationary texture, multiple generation autoliths, and a single nucleated accretionary autoliths (globular segregations) with a spinel lherzolite core.**

#37 (standard size) This thin section consists almost entirely of the nucleated accretionary autolith described in samples # 32-36. It is a **Type 2 nucleated accretionary autolith of moderately carbonatized, macrocrystic/microcrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite with local segregationary texture, mantling a spinel lherzolite nodule.**

#38 (standard size) This thin section is dominated by a 2.0 x 2.6 cm rounded Type 4 autolith that contains numerous smaller rounded Type 3 autoliths that range to as much as 3mm. These included Type 3 autoliths are characteristically enriched in phlogopite and opaque oxides and perovskite, and many are cored by serpentinized olivine macrocrysts. One small Type 3 autolith is cored by a subrounded grain (~ 1.2 mm across) of ilmenite. The large Type 4 autolith is moderately enriched in macrocrysts, but highly enriched in microcrysts (especially those < 0.3mm) and groundmass microphenocrysts of serpentinized olivine that locally comprises as much as 70% of the rounded fragment. This autolith appears to have a much lower opaque mineral, xenocrystic phlogopite and groundmass carbonate content than either the host kimberlite or the smaller Type 1 autolith population. Necklacing of serpentinized olivine macrocrysts and microcrysts is relatively uncommon except on xenocrysts within included earlier generation Type 3 autoliths. Degree of carbonatization of serpentinized olivine and groundmass serpentine is considerably greater than that in host kimberlite and other autolith populations. This

Type 4 autolith might be best designated as an **extensively carbonatized, autolithic, macrocrystic, strongly microcrystic, hypabyssal, phlogopite-bearing, serpentine kimberlite.**

The large Type 4 autolith comprises about ½ of the thin section and is enclosed in a typical Type 1 autolith rich host with prominently macrocrystic and segregationary textures. The Type 1 autoliths range to about 3mm and appear to be very similar in composition to the host kimberlite, although they contain somewhat higher concentrations of opaque minerals and less groundmass carbonate due to limited presence of calcite pools. Single autoliths of Type 4A and opaque oxide/perovskite rich Type 1A were observed. The Type 1A autolith (~ 2.3mm) is cored by a 1.9mm long macrocryst of serpentinized olivine, whereas the 2.4mm less carbonatized Type 4A autolith is not cored. A single 1cm portion of a Type 2 accretionary autolith is present at one edge of the thin section. This autolith exhibits weak concentric segregationary layering of mineral clasts as well as a modest alignment of elongate clasts.

The groundmass kimberlite and smaller Type 1 autoliths are characterized by abundant small opaque oxide mineral grains, many of which necklace macrocrysts and microcrysts of serpentinized olivine. The subhedral to nearly euhedral nature of much of the groundmass serpentine in both host kimberlite and autoliths infers replacement of abundant primary microphenocrystic olivine. This serpentine is locally replaced by calcite that has preserved the original texture. Irregular pools of coarse calcite are relatively common in the host kimberlite, and these are especially common adjacent to autoliths. Although serpentinized olivine grains are locally carbonatized, degree of replacement generally is minor. Microcrysts and small macrocrysts of phlogopite are relatively common in both the small Type 1 autoliths and host kimberlite, but no primary groundmass phlogopite was observed. Microcrysts of ilmenite and spinel also are present but not common. The groundmass appears to be dominated by serpentine locally replaced by carbonate, but some carbonate apparently is primary, especially that in pools. This rock might best be described as a **moderately carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral rich, calcite serpentine kimberlite with pronounced segregationary texture and multiple generation autoliths.**

<u>#39 (standard size)</u> This sample is essentially the same as Sample #38 except that the Type 4 autolith fragment is larger (nearly 3cm long) and comprises about 50% of the thin section. This autolith also contains numerous rounded Type 3 autoliths, but the phlogopite in many of these is more chloritized than in the previous sample. Carbonate pools are considerably more abundant in host kimberlite, and are slightly more abundant in the large Type 4 autolith. Furthermore, a higher percentage of the small Type 1 autoliths in the host kimberlite are cored by moderate to large serpentinized olivine macrocrysts, and one autolith is cored by a 0.8 mm phlogopite macrocryst. The host kimberlite in this sample might best be designated a **moderately carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral rich, calcite serpentine kimberlite with pronounced segregationary texture.**

#40 (standard size) Two large (+1 cm), well rounded concentrically layered autoliths (non-cored Type 2) and numerous small cored and non-cored Type 1 autoliths and several irregular subrounded Type 4A autoliths are set in a serpentinized olivine macrocryst/microcryst rich host with a mesostasis dominated by coarse pool calcite and finely crystalline mixtures of calcite and serpentine. Serpentine groundmass is variably replaced by carbonate. The subhedral to nearly euhedral nature of much of the groundmass serpentine in both host kimberlite and autoliths infers replacement of abundant primary microphenocrystic olivine. This serpentine is locally replaced by calcite that has preserved the original texture. The groundmass contains abundant opaque oxide minerals and lesser perovskite, both of which also typically occur as necklaces on serpentinized olivine macrocrysts and microcrysts. The latter exhibit minor replacement by carbonate, although those within autoliths are more extensively carbonatized. Macrocrysts and microcrysts of phlogopite also are present, but are more abundant in autoliths. A single small macrocryst and several microcrysts of ilmenite were observed in the host kimberlite, and microcrysts are present in several of the autoliths. Autoliths, other than the Type 4 variety, are characteristically more enriched in opaque minerals than the host kimberlite, and lack significant pool calcite. Furthermore, groundmass serpentine is more extensively replaced by carbonate as are microcrysts and microphenocrysts of serpentinized olivine. Most of the small cored Type 1 autoliths are nucleated on serpentinized olivine macrocrysts and/or microcrysts, but a few are cored by phlogopite. The concentric layering in the large rounded Type 2 accretionary autoliths reflects grain size variation imparted by greater versus less enrichment in macrocrysts and microcrysts. The accretionary autoliths are somewhat more enriched in phlogopite than Type 1 autoliths and host kimberlite. The kimberlite in both Type 1 and 2 autoliths might best be referred to as **moderately carbonatized, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, calcite serpentine kimberlite.**

One Type 1 autolith contains a small (1.3mm), well rounded autolith that is similar to Type 1 autolith kimberlite in containing macrocrysts and microcrysts of variably carbonatized serpentinized olivine and moderate amounts of opaque oxides and perovskite, some of which necklace olivine macrocrysts and microcrysts. Furthermore, it has a groundmass of variably carbonatized microphenocrysts and tiny microcrysts of serpentinized olivine in a mesostasis of microcrystalline to cryptocrystalline serpentine, locally replaced by carbonate, and small laths of locally chloritized phlogopite. However, it is characterized by the presence of abundant, randomly oriented prisms (as much as 0.22mm long) of completely carbonatized apatite. This autolith is referred to as Type 1B, and is composed of **moderately carbonatized, microcrystic/macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral-rich, apatite calcite serpentine kimberlite**.

Two irregularly shaped, moderately carbonatized autoliths (~ 1.1cm and 3.6mm respectively) are characterized by abundant laths of probable phlogopite, most of which are completely replaced by dusky gray carbonate. The phlogopite laths occur in a decussate array and individual laths range to in excess of 0.5mm. Limited numbers of serpentinized olivine macrocrysts are present, but microcrysts are relatively abundant. Neither the macrocrysts nor microcrysts are appreciably carbonatized. The groundmass is comprised of variable amounts of mostly carbonatized tiny (most < 0.013mm) microphenocrysts and/or microcrysts of probable serpentinized olivine set in a mesostasis of microcrystalline to cryptocrystalline serpentine that is locally replaced by carbonate. Some irregular areas in the groundmass appear to have been pools dominated by serpentine, and these areas locally exhibit recrystallization of cryptocrystalline serpophitic (?) serpentine to microcrystalline aggregates of lizardite (?). The opaque mineral and perovskite population is quite limited, and grains rarely exceed 0.2mm. Small, rounded Type 3 phlogopite and opaque mineral/perovskite rich autoliths are relatively common, but most are less than 0.4mm across. These typically are cored by necklaced serpentinized olivine microcrysts, and phlogopite is extensively chloritized.

This sample might best be designated a **moderately carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral rich, calcite serpentine kimberlite with pronounced segregationary texture and multiple generation autoliths.**

#41 (standard size) This sample is very similar to samples #38 and 39. The large (2.5cm) irregular subangular Type 4 autolith that dominates the slide is substantially more enriched in serpentinized olivine microcrysts and microphenocrysts than the host kimberlite, contains significantly less opaque oxide minerals, lacks carbonate pools in the groundmass, and is characterized by more extensive carbonatization of groundmass, xenocryst, and microphenocryst serpentine. Furthermore, this autolith contains a considerably higher concentration of intensely altered crustal wallrock fragments. Small Type 3 autoliths (as much as 5.6mm across) within this Type 4 autolith are very enriched in phlogopite, opaque oxide minerals and perovskite, and most are cored by extensively carbonatized, serpentinized olivine macrocrysts. Type 1 autoliths numerically dominate the overall autolith population, and these typically are cored by variably carbonatized serpentinized olivine macrocrysts or are non-cored. Two Type 4A autoliths with moderately abundant, fine grained chloritized phlogopite are present, as well as a 4mm portion of a Type 4A autolith with abundant decussate laths of completely carbonatized phlogopite. This overall sample is designated as a **moderately carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral rich, calcite serpentine kimberlite with segregationary texture and multiple generation autoliths.**

#42 (standard size) This sample is similar to Sample #41 but instead of a large Type 4 autolith it contains two small ones (< 1mm) that are macrocryst free. Also present are three Type 4A autoliths; two about 4mm in diameter that contain minor amounts of fine grained chloritized phlogopite, and one that is 2.4mm across and contains abundant completely carbonatized laths with decussate texture. At least half of the abundant Type 1 autoliths are cored with variably carbonatized serpentinized olivine macrocrysts, and several are cored by intensely altered wallrock fragments. An 8mm long subangular fragment of limestone is thinly mantled by Type 1 kimberlite, as is a 3.4mm long subrounded fragment of chlorite rimmed, chloritized and carbonatized diorite (?). The sample is designated a **moderately carbonatized, autolithic, macrocrystic, hypabyssal,**

perovskite and phlogopite-bearing, opaque mineral rich, calcite serpentine kimberlite with segregationary texture and multiple generation autoliths.

#43 (standard size) This sample is very similar to the last several samples described. It contains a single large, subangular Type 4 autolith (~ 1.2cm across) that has several included phlogopite and opaque mineral/perovskite rich Type 3 autoliths (up to 2.2mm) and intensely altered, angular to subangular fragments of sedimentary wallrock material. It is partially irregularly rimmed by Type 4 A autolith kimberlite characterized by limited serpentinized olivine microcryst content, moderate amounts of fine grained chloritized phlogopite, and abundant microcrystalline to cryptocrystalline matrix serpentine. Three small isolated Type 4A autoliths (< 3.4mm) of similar composition are present along with a single Type 4A autolith (~ 5mm long) characterized by abundant laths of decussate textured, intensely chloritized and carbonatized phlogopite. As with previous samples, the autolith population is dominated by the Type 1 variety. The host kimberlite is characterized by a serpentine rich groundmass with abundant irregular pools of coarsely crystalline calcite. Opaque mineral necklaces on serpentinized olivine macrocrysts and microcrysts are abundant in both host kimberlite and Type 1 autoliths. This sample is designated a **moderately carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral rich, calcite serpentine kimberlite with segregationary texture and multiple generation autoliths.**

#44 (standard size) This sample is very similar to sample #43 except Type 1 autoliths almost completely dominate the population volumetrically. Consequently the thin section is more enriched in macrocrysts of serpentinized olivine and slightly more enriched in macrocrysts and microcrysts of phlogopite. However, a number of small autoliths (all < 1.8mm) of other types are present. Four serpentinized olivine microcryst rich Type 4 autoliths were observed, and two of these contain limited amounts of dusky gray, completely carbonatized, elongate laths of phlogopite as well as the more normal fine grained, intensely chloritized variety. Two rounded Type 4A autoliths also are present, and these are characterized by a near absence of serpentinized olivine xenocrysts, and an abundance of matrix serpentine. These also contain small amounts of fine grained chloritized phlogopite, but only rare crystals of the generally common dusky gray, carbonatized laths. A 7mm nodule of intensely altered spinel lherzolite also is present.

Type 1 autoliths and host kimberlite are characterized by an abundance of opaque mineral necklaces on moderately carbonatized, serpentinized olivine macrocrysts and microcrysts. Irregular pools of coarsely crystalline calcite are common in the host kimberlite groundmass, and local irregular pools of serpentine commonly are invaded by prismatic to blocky crystals of calcite. Perovskite is moderately abundant in Type 1 autoliths and host kimberlite, and most is partially to completely altered to mixtures of kassite [$CaTi_2O_4(OH)_2$], anatase and titanite (sphene). The sample is best designated a **moderately carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral rich, calcite serpentine kimberlite with segregationary texture, multiple generation autoliths and a small spinel lherzolite nodule.**

#45 (standard size) This thin section is rather poor in that it is very small and badly wedged. However, it is essentially the same as Sample #44 but lacks any of the peridotite nodule that occurs in that sample. It is dominated by Type 1 autoliths as are all Bonus pipe samples, but also contains a 2.4cm wide fragment of an accretionary Type 2 autolith. It is designated a **moderately carbonatized, autolithic, macrocrystic, hypabyssal, perovskite and phlogopite-bearing, opaque mineral rich, calcite serpentine kimberlite with segregationary texture and multiple generation autoliths.**

Ram-6 Diatreme—Thin Sections from Core Samples from Ram-6-3 DDH

101.10 Metre Interval

R-3 (101.10 m, standard size) This sample is a moderately foliated, angular to subangular sedimentary rock fragment and rounded to subrounded, variably silicified, serpentinized olivine macrocryst, macrocryst fragment and microcryst rich, kimberlite breccia. Pelletal lapilli cored by silicified serpentinized olivine, sedimentary rock fragments, and locally, kimberlite autoliths, phlogopite macrocrysts, or altered clinopyroxene macrocrysts are relatively common. Small subrounded, non-mantled autoliths also are relatively common. Many of the elongate macrocrysts and macrocryst fragments of silicified serpentinized olivine and phlogopite as well as elongate xenoliths are roughly aligned inferring relatively pronounced flow during emplacement (flow [?] foliation). Silicified serpentinized olivine microcrysts and small lithic fragments also impart a "flow" fabric locally. Many thin (<0.1mm wide) veins of clear, low birefringence, optically positive, locally finely fibrous, probable gypsum and/or possible Ca zeolite (e.g., thomsonite or heulandite) subparallel the roughly planar rock fabric, although a few of these veins are crosscutting.

The sedimentary rock clast population is dominated by very fine to relatively coarse grained carbonate, but some shale and siltstone also are present. However, most of the argillaceous and arenaceous population appears to have been substantially carbonatized. One subangular shale fragment is highly enriched in kerogen and exhibits no carbonate replacement. This xenolith is probably oil shale and is mantled by a thin, discontinuous layer of fine grained kimberlite and apparently cores a pelletal lapillus. Several moderately sized (as much as 4mm long) xenoliths consist of complex arrays of interfingering prisms of probable tremolite. Groups of arrays exhibit different optical orientations and apparently reflect a coarsely crystalline, monomineralic rock that has been completely replaced. The original rock most likely was a pyroxenite. Several almost completely carbonatized rock fragments contain abundant to moderately abundant serpentinized and locally carbonatized grains that may have been macrocrysts and microcrysts of olivine and possibly some orthopyroxene. These xenoliths also appear to have been phlogopite bearing, although most of the primary mineral laths are now completely replaced by carbonate. It is suggested that these xenoliths may be relict lamprophyre.

The xenocryst population consists of silicified and locally carbonatized serpentinized olivine, phlogopite, carbonate, quartz, opaque oxides (spinel and ilmenite), and rare clinopyroxene (mostly altered). Silicified serpentinized olivine macrocrysts range to 2mm long and exhibit only minor replacement by carbonate. They contain variable amounts of irregular opaque minerals (possibly pyrrhotite), and fine needles of millerite are relatively common. Larger macrocrysts are extensively replaced by interlocking elongate grains of quartz and minor talc, whereas smaller macrocrysts, microcrysts and small fragments tend to be replaced by microcrystalline to cryptocrystalline quartz and talc. Microcrysts and small fragments are very abundant and commonly are partially to completely carbonatized. Some of the microcrysts may be pyroxene, but complete alteration has obliterated any supporting evidence. Euhedral laths to subrounded grains of phlogopite range to 1mm long and most exhibit a pronounced alignment parallel to the "flow" fabric. The phlogopite is essentially unaltered and shows little to no zonation. Angular xenocrysts of carbonate and quartz are present but not especially abundant. Angular to rounded xenocrysts of spinel and ilmenite are relatively common but do not exceed 0.3mm in size. Two xenocrysts (both < 1.4mm) of altered clinopyroxene were observed. Although some primary material is preserved, the majority of both grains have been replaced by tremolite (?) +/- anthophyllite (?), phlogopite and quartz.

The pelletal lapilli range to 4mm long and typically are cored by silicified serpentinized olivine macrocrysts, although some are cored by xenoliths and a few by autoliths, or macrocrysts of phlogopite or clinopyroxene. One autolith is cored by a macrocryst that appears to have been amphibolitized pyroxene, but only small amounts of relict amphibole (pargasite?) have survived extensive alteration to tremolite (?), phlogopite and quartz. The core autoliths are very similar to many of the autoliths that occur in the previously described hypabyssal samples from the Bonus Pipe, and may be comparable in origin. The kimberlite that comprises most of the lapilli tends to be finer grained, lower in opaque minerals and perovskite, and more intensely carbonatized than the host kimberlite. In many of the cored lapilli elongate minerals are locally aligned parallel or subparallel to margins of the core material. No grain alignment was observed in non-cored lapilli (?) or autoliths (?). Most of the lapilli kimberlite is dominated by microcrysts and microphenocrysts of almost completely carbonatized, serpentinized olivine. These are set in a matrix of finely crystalline serpentine that has been mostly replaced by carbonate and cryptocrystalline quartz (?). Other matrix constituents include variable amounts of opaque minerals, intensely altered perovskite, and locally carbonatized phlogopite. This material might best designated as **predominantly cored, intensely carbonatized, microcrystic, opaque mineral-perovskite-phlogopite-bearing, serpentine kimberlite lapilli (?).**

Autoliths in the autolith cored lapilli (or autoliths with later generation kimberlite mantles) as well as isolated autoliths are characterized by a lower concentration of silicified serpentinized olivine microcrysts, presence of silicified serpentinized olivine macrocrysts, relatively abundant phlogopite microcrysts, local presence of groundmass phlogopite, and slightly higher concentration of opaque minerals and altered perovskite. Furthermore, microcrysts and macrocrysts exhibit only limited carbonatization, although the abundant serpentinized olivine microphenocrysts are nearly completely replaced by carbonate. Finely crystalline matrix serpentine also has been almost entirely replaced by carbonate. This autolith kimberlite is very similar to the Type 3A autoliths present in the Bonus Pipe samples. It might best be described as **variably carbonatized, macrocrystic/microcrystic, hypabyssal, perovskite/opaque mineral-phlogopite-bearing, calcite serpentine kimberlite.** Many lapilli and autoliths are characterized by the rather pervasive presence of irregular patches of brown to dark brown, isotropic material. This material also is present in the host kimberlite groundmass and may be kerogen derived from oil shale incorporated from the wallrock, although at least some may be hydrated Fe oxide mixtures.

The groundmass of this heterolithic breccia consists of a mixture of weakly to extensively carbonatized microcrysts and macrocryst fragments of silicified serpentinized olivine, small comminuted fragments of intensely altered, carbonate dominated sedimentary wallrocks, variably chloritized and/or serpentinized microcrysts of phlogopite, and small clasts of opaque minerals and altered perovskite set in a matrix of finely crystalline calcite and variably silicified and carbonatized microcrystalline to cryptocrystalline serpentine. Some of the calcite appears to be pseudomorphic after microphenocrysts or comminuted fragments of serpentinized olivine. Many irregular areas and stringer-like zones (some in excess of 1mm) between clasts are filled with gypsum (?) and/or Ca-rich zeolites similar to material present in crosscutting veinlets. Minor irregular zones of strained quartz also are present. Although this sample could be an ultramafic lamprophyre (aillikite), similarity of autoliths and general groundmass components with those in the Bonus Pipe of definite kimberlite affinity and close proximity of the two pipes would tend to favor a kimberlite designation for the Ram-6 breccias. Consequently, this sample is considered to be a **weakly foliated, variably carbonatized, silicified serpentinized olivine macrocryst/microcryst/fragment-rich, diatreme facies kimberlite heterolithic breccia, with abundant altered sedimentary wallrock clasts, autoliths and pelletal lapilli (?).**

R-4 (101.10 m, standard size) This sample is very similar to Sample R-3 but is dominated by a large (1.8cm long), weakly brecciated and annealed, intensely altered calcareous shale fragment. It contains abundant microcrysts, macrocrysts and fragments thereof of silicified serpentinized olivine, some of the former partially to completely carbonatized. Macrocryst interiors (areas where antigorite generally predominates) typically are replaced in large part by relatively coarse, interlocking bladed crystals of quartz with variable amounts of talc. Border zones and areas adjacent to internal fractures (areas generally occupied by chrysotile) generally are replaced by microcrystalline to cryptocrystalline quartz with variable amounts of very fine grained talc. Talc tends to be coarsest at contacts between macrocrystalline and microcrystalline/cryptocrystalline replacement quartz. Millerite and probable pyrrhotite are present in many of the macrocrysts. Microcrysts and small macrocrysts of phlogopite are relatively common, and microcrysts of spinel (locally rimmed by titanomagnetite) and ilmenite are present. Small, subrounded to subangular clasts of intensely altered sedimentary rock material is abundant, and small pelletal lapilli and autoliths also are present, but not as common as in Sample R-3. The only autolith type recognized that is comparable to those described from Bonus pipe thin sections is a Type 4. The matrix of this breccia is similar in texture and composition to that in Sample R-3, and it also contains irregular areas of gypsum and probable Ca-zeolites. This sample also exhibits a weak "flow" foliation that is locally accentuated by thin veinlets of gypsum +/- fibrous carbonate (aragonite?) +/- Ca-zeolites. Although similar to Sample R-3, it might better be referred to as a **weakly foliated, variably carbonatized, silicified serpentinized olivine macrocryst/microcryst/fragment-rich, diatreme facies kimberlite lithic breccia, with abundant altered sedimentary wallrock clasts, and minor pelletal lapilli (?) and autoliths.**

R-5 (101.10 m, standard size) This sample is essentially the same as Sample R-3, although it contains fewer cored pelletal lapilli and autoliths. One apparent cored lapillus is characterized by layers of two different generations of kimberlite. The outer layer is much thinner than the inner, and is comprised of fine grained, opaque mineral-perovskite and macrocryst/microcryst-poor, carbonatized serpentinized olivine microphenocryst-rich kimberlite that is similar in composition to many of the previously described lapilli and some Type 1 autoliths in Bonus pipe thin sections. The inner kimberlite mantles a rounded, partially carbonatized, serpentinized olivine microcryst, and is enriched in serpentinized olivine microcrysts (most non-carbonatized), extensively carbonatized serpentinized olivine microphenocrysts, and serpentine groundmass. Opaque minerals and altered perovskite are relatively common, as are laths of apparently serpentinized phlogopite. This kimberlite is roughly comparable to that in Type 3A autoliths in Bonus pipe samples and is very similar to that in previously described autoliths and some alleged lapilli. This might suggest that such lapilli more likely are autoliths. Several small isolated autoliths of Type 3A composition were observed as was a single autolith of the more phlogopite and opaque mineral/perovskite rich Type 3 kimberlite.

As in samples R-3 and R-4, most serpentinized olivine macrocrysts and microcrysts are extensively silicified, typically with bladed macrocrystalline quartz in macrocryst grain interiors and microcrystalline to cryptocrystalline quartz along macrocryst grain margins and internal fractures and completely replacing microcrysts. However, more serpentine is preserved in macrocrysts and microcrysts in this sample than in the previous two samples. Three subrounded to subangular macrocrysts of altered clinopyroxene also are present. Only minor relict pyroxene has been preserved; most of the macrocrysts having been replaced by quartz, tremolite and phlogopite.

The sample exhibits a weak "flow" foliation that is accentuated by parallel to subparallel veinlets of gypsum (?) +/- Ca-zeolites (?) +/- aragonite (?). Similar weakly birefringent secondary material also is relatively abundant in irregular to elongate zones within the breccia matrix. As with Sample R-3, this sample is probably best described as a **weakly foliated, variably carbonatized, silicified serpentinized olivine macrocryst/microcryst/fragment-rich, diatreme facies kimberlite heterolithic breccia, with abundant altered sedimentary wallrock clasts, autoliths and pelletal lapilli (?),** although the autolith-lapilli ratio is in question.

R-6 (101.10 m, standard size) This thin section is similar in general to the previous three samples, although foliation is less evident and moderately large rounded autoliths are somewhat more abundant. It is dominated by silicified serpentinized olivine macrocrysts, macrocryst fragments, and microcrysts, along with intensely altered fragments of wallrock sediments (shale, oil shale, siltstone [?] and carbonates). Small (most < 1mm), rounded to subrounded Type 3A and Type 4 autoliths are relatively abundant. The latter are typically enriched in small microcrysts of partially to completely carbonatized olivine and contain generally low concentrations of microphenocrysts of serpentinized olivine. These are set in a dusky matrix of carbonate and variable amounts of microcrystalline and cryptocrystalline serpentine. Small laths of groundmass phlogopite are relatively common, and these generally are partially replaced by chlorite and/or carbonate. Small crystals of extensively altered opaque oxides and perovskite are present but not abundant. The Type 3A autoliths typically are more enriched in phlogopite, both microcrystic and groundmass laths, as well as opaque oxides and perovskite, and commonly are cored by serpentinized olivine or phlogopite microcrysts. The groundmass is comprised primarily of minor to moderate amounts of carbonatized serpentinized olivine microphenocrysts and tiny microcrysts in a mesostasis of variably carbonatized microcrystalline serpentine. Irregular patches of brown to dark brown, isotropic material present in many of the autoliths may be either kerogen and/or Fe oxyhydroxides. Larger Type 3A autoliths range to 5mm, typically contain silicified serpentinized olivine macrocrysts as well as microcrysts and microphenocrysts, and are more enriched in phlogopite and opaque minerals and perovskite. Furthermore, a higher percentage of the groundmass serpentine has not been carbonatized. One such autolith (~ 2.4mm long) contains an earlier generation Type 3 (?) autolith that is cored with a small (2.2mm long) nodule of altered peridotite that contains some fresh clinopyroxene. The kimberlite in this autolith is very similar to that of its host autolith except it is considerably more enriched in opaque minerals and perovskite. Two other Type 3A autoliths (0.9mm and 1.7mm long) are cored by phlogopite macrocrysts, and mantled by a thin layer (< 0.15mm thick) of finer grained, serpentinized olivine microcryst-microphenocryst rich kimberlite that is poorer in opaque minerals, perovskite and phlogopite than the inner layer kimberlite. Furthermore, serpentine in this mantle kimberlite has been more intensely carbonatized than that which it mantles. These composite features are lapilli with cored autolith cores, and the mantle material is similar in composition to other lapilli in the section.

Some variably silicified serpentinized macrocrysts contain irregular subrounded zones of apparently contiguous, very pale green lizardite (?) that characteristically exhibits strain, very low birefringence and 2V (essentially 0), and an apparent uniaxial negative sign. This kimberlite breccia also contains relatively abundant macrocrysts and microcrysts of phlogopite and microcrysts of both spinel and ilmenite are present. The breccia groundmass is similar to that in previously described RAM-6 sections, and many interclast areas have been infilled with gypsum and/or Ca-zeolites. Numerous subparallel veinlets of gypsum +/- Ca-zeolites +/ aragonite (or fibrous calcite) +/- minor quartz crosscut the breccia and accentuate a very weakly defined foliation imparted by elongate rock and mineral clasts (especially phlogopite macrocrysts and microcrysts). This rock might best be classified as a **very weakly foliated, variably carbonatized, silicified serpentinized olivine macrocryst/microcryst/fragment-rich, autolithic, diatreme facies kimberlite heterolithic breccia, with abundant altered sedimentary wallrock clasts, autoliths and pelletal lapilli (?).**

R-7 (101.10 m, oversize) This sample is very similar to the previously described Ram-6 thin sections except it contains a very high percentage of small (typically < 0.8mm), fine grained, rounded to subrounded pelletal lapilli (many cored by intensely altered sedimentary rock fragments) and fewer large lapilli mantling macrocrysts of silicified serpentinized olivine and/or pyroxene or phlogopite. Autoliths of coarser hypabyssal kimberlite also are considerably less common, and these are mostly of the Type 3A variety (a single small Type 3 autolith also observed). Well rounded to subangular fragments of intensely altered sedimentary rocks (shale, siltstone, mudstone and carbonates) are abundant as are macrocrysts, microcrysts and fragments thereof of silicified serpentinized olivine. A few macrocrysts and microcrysts of phlogopite and intensely altered clinopyroxene also are present, minor relicts commonly preserved in the latter. Silicification of serpentinized olivine is similar to that described in previous Ram-6 samples as is alteration of pyroxene. Both olivine and pyroxene macrocrysts are locally partially replaced by macrocrystalline calcite. A single elongate grain (~ 0.5mm long) of fresh garnet with a thin kelyphitic rim is present as are several small grains (most < 0.25mm) of reddish to pale brown spinel rimmed by opaque titanomagnetite. A single subrounded xenolith (~1.4 x 2.4mm) coring a lapillus is composed of about 40% biotite and 60% calcite with minor opaque minerals. This rock could be a biotite/phlogopite marble (sovite), but also could have been a biotite tonalite in which all of the feldspar was replaced by carbonate.

Elongate macrocrysts, microcrysts and fragments of xenocrysts and wallrock exhibit a relatively strong subparallel alignment that imparts a moderately pronounced flow foliation to the sample. This foliation is accentuated by the presence of relatively abundant veinlets of quartz +/- calcite/aragonite (+/- gypsum +/- zeolites [?]) roughly parallel to the foliation. Several elongate zones enriched in Fe oxyhydroxides also are subparallel to foliation inferring later introduction of Fe rich fluids along foliation cleavage surfaces. The groundmass of this sample is characterized by an abundance (~ 40%) of microphenocrysts and tiny microcrysts (most < 0.0125mm) of calcite apparently pseudomorphic after serpentinized olivine. Larger microcrysts (up to and in excess of 0.05mm) also may be completely carbonatized but commonly are characterized by serpentine and minor microcrystalline talc. Small laths of phlogopite commonly are partially to completely replaced by carbonate. Some microcrystalline serpentine may be present in the mesostasis, but secondary carbonate appears to predominate. The presence of apparently abundant groundmass olivine and phlogopite with probable primary serpentine favors a kimberlite as opposed to ultramafic lamprophyre affinity. Consequently, this sample is designated as a **moderately foliated, variably carbonatized, silicified serpentinized olivine macrocryst/microcryst/fragment-rich, diatreme facies kimberlite heterolithic breccia, with abundant pelletal lapilli and altered sedimentary rock fragments, minor autoliths, and a garnet macrocryst.**

R-8 (101.10 m, oversize) This sample is very similar to Sample R-7 in being dominated by relatively small, well rounded pelletal lapilli and silicified serpentinized olivine macrocrysts, microcrysts and subangular to subrounded fragments of silicified serpentinized olivine. Well rounded to subangular fragments of intensely altered wallrock sediments (mostly shale siltstone and mudstone with minor carbonate) also are abundant. As in Sample R-8, autoliths (mostly Type 3A, but also single examples of Type 3 and Type 4) are present but not abundant. Macrocrysts typically are replaced by macrocrystalline bladed quartz and minor talc in their interiors, whereas borders and areas adjacent to internal fractures generally are replaced by microcrystalline to cryptocrystalline quartz and talc. Microcrysts and macrocryst fragments generally are replaced by microcrystalline to cryptocrystalline quartz and talc. Acicular needles of millerite are common in many of the macrocrysts and appear to be best preserved in areas of replaced by microcrystalline to cryptocrystalline quartz and talc. Interior quartz is replaced locally by relatively coarse crystals (> 0.15mm) of carbonate. Several macrocrysts and microcrysts of clinopyroxene (diopside?) also are present and typically are primarily or completely replaced by tremolite (?), phlogopite and quartz. Macrocrysts and microcrysts of phlogopite are relatively common, and several small macrocrysts and large microcrysts of ilmenite and reddish brown spinel also are present. The spinel typically is rimmed by opaque titanomagnetite. Two garnet grains with kelyphitic rims were observed. One of the grains is almost completely kelyphitized, the relict garnet being about 0.08 x 0.30mm coring a kelyphitic mass rich in phlogopite that is about 0.30 x 0.85mm. The second garnet grain is included within a silicified serpentinized olivine macrocryst, is about 0.4mm across, and has only a thin kelyphite rim (mostly < 0.05mm wide). As with Sample R-7, this sample might best be designated a **moderately foliated, variably carbonatized, silicified serpentinized olivine macrocryst/microcryst/fragment-rich, diatreme facies kimberlite heterolithic breccia, with abundant pelletal lapilli and altered sedimentary rock fragments, minor autoliths, and two garnet macrocrysts.**

R-9 (101.10 m, oversize) This sample is very similar to the previous two in containing abundant small pelletal lapilli, intensely altered sedimentary wallrock fragments, and silicified serpentinized olivine macrocrysts, microcrysts and macrocryst fragments. However, it also contains several large (up to 1cm across) rounded autoliths (mostly Type 3A, one Type 4) that comprise nearly 15% of the thin section volume. Furthermore, it also contains several large (as much as 4.4mm) lapilli that are cored by silicified serpentinized olivine macrocrysts, phlogopite macrocrysts, autoliths and sedimentary rock fragments. As with cored lapilli in previously described samples, the mantling kimberlite material typically is finer grained and lower in opaque oxides and perovskite than autolithic kimberlite, and mantles generally are less than 0.1mm thick. One lapillus is cored by an angular grain of fresh diopside that is ~ 0.4 x 0.6mm. Small macrocrysts up to about 0.6mm long also are present. A thin zone (~ 0.1 to 0.15mm wide) of finely comminuted material occurs adjacent and subparallel to the 1cm autolith. This sample might best be designated a **moderately foliated, variably carbonatized, silicified serpentinized olivine macrocryst/microcryst/fragment-rich, diatreme facies kimberlite heterolithic breccia, with abundant pelletal lapilli, autoliths and altered sedimentary rock fragments.**

R-10 (101.10 m, oversize) This sample is similar to Samples R-7 and R-8 in containing abundant small pelletal lapilli and fewer autoliths (exclusively Type 3A); however, it is more like Sample R-9 in containing abundant larger lapilli cored by silicified serpentinized olivine macrocrysts and sedimentary wallrock fragments. It also contains xenoliths of phlogopite marble (?) (sovite) and tremolitized (?) pyroxenite that are approximately 1.4mm and 6.4mm across respectively. As with the previously described autolith deficient samples, this sample should be designated as a **moderately foliated, variably carbonatized, silicified serpentinized olivine macrocryst/microcryst/fragment-rich, diatreme facies kimberlite heterolithic breccia, with abundant pelletal lapilli and altered sedimentary rock fragments, and minor autoliths.**

R-11 (101.10 m, standard size) This sample is very similar to Sample R-4 in that nearly 1/3 of the thin section is occupied by a 1.5cm long subrounded, elongate xenolith of weakly brecciated and annealed, intensely altered calcareous shale. It also contains abundant macrocrysts, microcrysts and macrocryst fragments of silicified serpentinized olivine, replaced locally by carbonate and/or talc, and with locally common millerite needles. However, small pelletal lapilli are far more common as are lapilli cored with macrocrysts, sedimentary rock fragments, and autoliths. Furthermore, autoliths are relatively common, and some of these are rimmed by a later generation of kimberlite that in turn is mantled by finer grained, opaque oxide/perovskite poor kimberlite characteristic of lapilli material. Type 3A autoliths dominate, but both Type 3 and 4 also are present and commonly are rimmed by lapilli kimberlite. Some lapilli are cored by fresh to almost completely altered fragments of diopside (?). One such core consists of two intergrown grains (~ 2.8mm across) that exhibit differential replacement. One of the grains is partially altered to biotite along cleavage traces but at its margin with kimberlite it is replaced by a mixture of amphibole, biotite, quartz and calcite. The second grain is about 20% replaced by small biotite laths and 30% replaced by amphibole (tremolite?) prisms (most < 0.1mm long) along cleavage traces. A single amphibole crystal (~ 0.3 x 0.7mm long) has replaced a significant portion of the diopside crystal, and the amphibole cleavage traces are accentuated by the presence of abundant rutile prisms (~ 0.0125-0.0375mm long). The sample is very similar to Sample R-3 in this respect. Subrounded to subangular fragments of intensely altered wallrock shale, siltstone, mudstone and carbonate are common and a single xenolith of phlogopite marble (?) (sovite) was observed. This sample might best be designated a **weakly foliated, variably carbonatized, silicified serpentinized olivine macrocryst/microcryst/fragment-rich, diatreme facies kimberlite heterolithic breccia, with abundant altered sedimentary wallrock clasts, autoliths and pelletal lapilli.**

110.20 Metre Interval

R-12 (110.20 m, standard size) This sample is basically similar to samples from the 101.1 metre level in being relatively enriched in sedimentary wallrock clasts, autoliths, pelletal lapilli and macrocrysts, microcrysts and macrocryst fragments of silicified serpentinized olivine. However, concentration of xenolithic material tends to be lower, especially pelletal lapilli, and the groundmass is prominently crystallinoclastic, containing from 10-25% angular to subrounded clasts of quartz and feldspar. The sample has a weak foliation imparted primarily by a subparallel alignment of elongate macrocrysts, microcrysts and fragments of silicified serpentinized olivine, along with phlogopite macrocrysts and microcrysts and elongate sedimentary rock clasts. Elongate felsic mineral clasts in the groundmass also are locally preferentially aligned. This weak foliation is accentuated by the presence of parallel to subparallel veinlets of quartz, although minor amounts of carbonate +/- gypsum +/- zeolite also may be present. Sedimentary rocks dominate the xenolith population as in level 101.1 metre samples, and include primarily intensely altered and variably carbonatized shale, siltstone and mudstone. Macrocrystalline limestone and dolostone also are present, and a few small siltstone fragments are characterized by abundant Fe oxyhydroxide cement and/or kerogen material.

Pelletal lapilli comprise only 1-2% of the slide volume, and are primarily cored by phlogopite, sedimentary rock fragments, and silicified serpentinized olivine macrocrysts and microcrysts. However, some occur as small, rounded non-cored features and a few are cored by autoliths. Lapilli kimberlite typically is finer grained and more deficient in opaque oxide minerals and perovskite than autolith kimberlite, and generally is nearly completely replaced by carbonate. It might best be referred to as **intensely carbonatized, microcrystic, hypabyssal, variably silicified serpentine kimberlite.** Autoliths comprise about 5-8% of the slide volume, are typically subrounded, range from about 0.3 to 5.0mm long, and are exclusively Type 3A variety. Larger autoliths contain abundant macrocrysts and microcrysts of locally silicified serpentinized olivine, but most are extensively to completely replaced by carbonate, although serpentine is present in some. Phlogopite occurs as macrocrysts and microcrysts as well as a minor groundmass phase, the latter generally replaced by carbonate. Variably altered grains (most < 0.025mm) of opaque minerals and perovskite are very abundant in the groundmass, the mesostasis of which is comprised primarily of microcrystalline carbonate. However, much of the carbonate appears to have replaced microphenocrysts and microcrysts of olivine. Some microcrystalline to cryptocrystalline quartz also occurs in the matrix, and this along with carbonate apparently has replaced most of the primary serpentine that may have been present. Small autoliths are almost completely carbonatized but probable pseudomorphs of olivine microphenocrysts and small microcrysts are evident in most. Most, if not all, of the autoliths might best be described as **variably carbonatized, macrocrystic/microcrystic, hypabyssal, perovskite-opaque mineral-phlogopite bearing, calcite serpentine kimberlite.**

More than 30% of the volume of this thin section is comprised by silicified serpentinized olivine microcrysts, macrocryst/microcryst fragments and macrocrysts. Silicification of these xenocrysts is similar to that in 101.1 metre level samples, interiors of larger grains dominated by macrocrystalline bladed quartz, whereas border zones and some areas adjacent to internal fractures are replaced primarily by mixtures of microcrystalline to cryptocrystalline quartz and variable amounts of fibrous talc. Coarser grained talc commonly occurs within bladed quartz replacement areas as well as along margins between replacement quartz types. Microcrysts and smaller fragments of macrocrysts typically are almost completely replaced by mixtures of microcrystalline to cryptocrystalline quartz and talc. Macrocrysts generally exhibit only minor replacement by carbonate, whereas microcrysts commonly are completely carbonatized. Many macrocrysts contain small acicular crystals of millerite and irregular grains of probable pyrrhotite. Macrocrysts (up to 1m long) and microcrysts of phlogopite are relatively common, and a few microcrysts of spinel and ilmenite (?) also are present. An orange brown spinel xenocryst (~0.45mm across) is rimmed by opaque titanomagnetite. Rare grains of diopside (as much as 0.2mm long) also are present. The small xenocryst population (most grains < 0.2mm) is dramatically different from that in samples from the 101.1 metre level. Angular to subangular and rarely rounded clasts of quartz and lesser feldspar comprise as much as 20% of the breccia groundmass area. A few apparent clasts of carbonate also are present. The remainder of the groundmass is very similar to that in shallower level Ram-6 samples. Abundant small microcrysts and microphenocrysts of completely carbonatized, serpentinized olivine are set in a mesostasis of apparently microcrystalline serpentine that has been mostly replaced by carbonate and cryptocrystalline quartz. Isolated small laths of phlogopite also are present as are small grains of altered opaque oxides and perovskite; however, these mineral phases are all considerably less abundant than their counterparts in the matrix of autoliths. Irregular areas and veinlets filled with quartz and minor local calcite and/or aragonite, gypsum (?) and zeolite (?) are relatively common. The quartz content of these zones is considerable greater than comparable areas in shallower level samples.

This sample clearly was derived from a source with a wallrock contribution high in quartz and feldspar (e.g., arkosic sandstone, arenaceous mudstone, or granitoid). Samples from the 101.1 metre level contain very few felsic mineral clasts, thus probably reflect melt transport that by-passed the source of the 110.2 metre parent melt, and very likely reflect a slightly earlier intrusive phase. This sample might best be referred to as a **weakly foliated, autolith bearing, variably carbonatized, silicified serpentinized olivine microcryst/macrocryst fragment/macrocryst-rich, crystallinoclastic, diatreme facies kimberlite heterolithic breccia, with abundant intensely altered sedimentary wallrock clasts.**

<u>R-14 (110.20 m, standard size)</u> This thin section is dominated by a single subangular xenolith of calcareous shale that is 1.8cm across. The enclosing kimberlite breccia is weakly to moderately well foliated and is very similar in most respects to Sample R-12. However, pelletal lapilli are relatively rare, autoliths (again exclusively Type 3A) comprise only about 5% of the thin section volume, and silicified serpentinized olivine macrocrysts are significantly more abundant. The felsic mineral clast content of the breccia matrix also is significantly higher, ranging to nearly 50% locally. The xenolith population is dominated by calcareous shale, but arenaceous limestone and microcrystalline limestone fragments also are common. Autoliths typically are well rounded to subrounded, although the largest autolith (~ 2mm across) in the sample is subangular and corroded. Three of the autoliths are cored; two by a 0.8mm long and 0.4mm long macrocryst/microcryst respectively of silicified serpentinized olivine, and the other by a 0.8mm long macrocryst of phlogopite. The kimberlite in these autoliths and the non-cored autoliths is identical to that in Type 3 autoliths in Sample R-12. Minor small lapilli are characterized by compositions that are comparable to the breccia matrix. Alteration and replacement mineralogy of macrocrysts and microcrysts also is similar, but this sample contains a single macrocryst (~ 0.8mm across) of fresh brown amphibole (pargasite?). Its border zones and several cleavage traces are altered to fine grained

mixtures of biotite, quartz, fibrous amphibole (tremolite/actinolite) and very fine grained magnetite. The breccia matrix in this sample is similar to that in Sample R-12 except for the considerably higher felsic wallrock mineral clast content. Angular to subangular quartz grains are extremely abundant, and some feldspar is present. This rock might best be designated a **moderately foliated, variably carbonatized, autolith bearing, silicified serpentinized olivine macrocryst/microcryst/macrocryst fragment-rich, crystallinoclastic, diatreme facies kimberlite heterolithic breccia, with abundant altered sedimentary wallrock clasts.**

R-15 (110.20 m, standard size) As with Sample R-14, this sample is dominated by a large calcareous shale xenolith (~ 2cm long). However, this xenolith has been locally disrupted along fracture sets by the intruding kimberlite. Wallrock sediments also dominate the rest of the xenolith population, and most common are calcareous shale, siltstone and mudstone as well as macro- to microcrystalline limestone. Pelletal lapilli are relatively rare and have compositions approximately comparable to the breccia matrix. Autoliths are slightly less abundant than in Sample R-14 and comprise about 5% of the thin section volume. The autoliths characteristically are subrounded, range to 1.8mm long, and several are cored by macrocrysts of silicified serpentinized olivine or phlogopite. Most are Type 3 autoliths enriched in phlogopite, both xenocrystic and groundmass laths, and have a groundmass of moderate amounts of carbonatized microphenocryst and small microcrysts of serpentinized olivine set in a mesostasis of microcrystalline carbonate, serpentine and micro- to cryptocrystalline quartz. A single Type 3 autolith is present and is characterized by very abundant tiny grains of altered opaque oxides and perovskite (> 20% of the matrix locally), more primary serpentine, and small prisms of apatite. It also contains abundant microcrysts of serpentinized olivine and phlogopite, and tiny laths of phlogopite are relatively common in the groundmass. It might be referred to as a **weakly carbonatized, microcrystic, hypabyssal, phlogopite bearing, perovskite/opaque mineral serpentine kimberlite.** A single small Type 4 autolith also is present, and typically exhibits extensive carbonatization of the small, serpentinized olivine microcrysts that dominate this autolith variety.

As in sample R-14, the macrocryst population is dominated by variably carbonatized, silicified serpentinized olivine, which also dominates the microcryst and macrocryst fragment populations. Subrounded phlogopite grains are present but rarely exceed 0.5mm in length. These xenocrysts along with elongate xenoliths tend to have a subparallel alignment that imparts a weak foliation to the rock. The most impressive feature of this sample is the very high concentration of angular to subangular quartz (and minor feldspar) grains in the groundmass that impart a very pronounced crystallinoclastic texture to the rock. This rock might best be designated a **weakly foliated, variably carbonatized, autolith bearing, silicified serpentinized olivine macrocryst/microcryst/macrocryst fragment-rich, strongly crystallinoclastic, diatreme facies kimberlite lithic breccia.**

R-16 (110.20 m, oversize) This sample also contains a large xenolith (~ 1.8cm long) of calcareous shale, but the overall sample is characterized by a lower sedimentary rock clast content (15-20%) than the previous samples. Pelletal lapilli are rare, and autoliths comprise less than 2% of the total thin section volume. Autoliths are exclusively Type 3A, and most are cored by silicified serpentinized olivine macrocrysts, and as in other samples they are variably carbonatized, relatively enriched in phlogopite and opaque minerals/perovskite, and contain abundant apparent carbonate pseudomorphs of microphenocrysts and small microcrysts of serpentinized olivine in the groundmass. Silicified serpentinized olivine macrocryst, microcrysts and macrocryst fragments comprise about 15-20% of the thin section volume and these generally have a roughly subparallel alignment that along with elongate sedimentary rock fragments and phlogopite clasts impart a crude foliation to the rock. Subrounded phlogopite laths, although relatively common, rarely exceed 0.6mm in length. A single macrocryst (~ 0.9 mm across) of red brown spinel with a very thin partial rim (~ 0.03 mm wide) of opaque titanomagnetite was observed. The most impressive feature of this sample is the profusion of angular to subangular clasts of quartz and minor feldspar in the breccia matrix. These comprise upwards to 50% of the groundmass total locally, and elongate grains exhibit some preferential parallel alignment that compliments that of larger elongate clasts. The rest of the matrix consists primarily of variably silicified microcrysts of serpentinized olivine, tiny phlogopite laths, and minor carbonatized microphenocrysts and tiny microcrysts of serpentinized olivine (?) in a mesostasis of microcrystalline to cryptocrystalline serpentine, carbonate and quartz. Many irregular and lenticular areas in the groundmass are highly enriched in Fe oxyhydroxides. These apparently are products of late introduction of Fe rich solutions along cleavage planes paralleling foliation. This sample might best be referred to as a **weakly foliated, variably carbonatized, autolith bearing, silicified serpentinized olivine macrocryst/microcryst/macrocryst fragment-rich, strongly crystallinoclastic, diatreme facies kimberlite lithic breccia.**

R-18 (110.20 m, oversize) This sample is dominated by a large xenolith (~ 2cm long) of locally kerogen rich, somewhat fossiliferous, argillaceous, microcrystalline limestone. Smaller fragments of similar limestone as well as clasts of coarser grained limestone, arenaceous limestone, calcareous shale and siltstone also are present and cumulatively comprise about 10% of the thin section. Pelletal lapilli are rare, but small rounded to subrounded "pelletal" autoliths are relatively common. Autoliths are exclusively Type 3A, range to as much as 1.8mm long and are identical in composition to those in previously described 110.2 metre interval samples. Many of the autoliths are cored by silicified serpentinized olivine macrocrysts or phlogopite macrocrysts. A single opaque oxide/perovskite rich Type 3 autolith is similar to one present in Sample R-15. About 30% of the sample is comprised of silicified serpentinized olivine macrocrysts, microcrysts and macrocryst fragments. Many of these contain fine needles of millerite and irregular masses and/or crystals of pyrrhotite. Macrocrysts and microcrysts of phlogopite (as much as 1.2mm long) are common as they are in autoliths. Several microcrysts and macrocrysts (some in excess of 1mm) of diopside also are present, and typically are extensively altered to mixtures of biotite, amphibole, quartz and magnetite. A few grains (as much as 0.9mm long) of red brown and pale orange brown spinel were observed. Several grains (< 0.6mm long) of probable ilmenite also are present. A single angular clast (~ 0.4mm across) of amphibole was noted, and it is slightly altered along its margins to microcrystalline quartz and tremolite.

The groundmass of this sample is very similar to that of Sample R-16 but its content of angular to subangular quartz and feldspar clasts is lower (~ 30-35%) and carbonate is higher. As in Sample R-16, many elongate groundmass clasts are aligned subparallel with elongate macrocryst, microcrysts, macrocryst fragments and xenolith to generate a weak foliation. Most fractures in this sample do not parallel foliation planes, and they are almost exclusively filled with quartz, although fibrous carbonate (aragonite?) is present locally. This sample might best be referred to as a **weakly foliated, variably carbonatized, autolith bearing, silicified serpentinized olivine macrocryst/microcryst/macrocryst fragment-rich, crystallinoclastic, diatreme facies kimberlite lithic breccia.**

R-19 (110.20 m, oversize) This sample is quite similar to Sample R-18 in being dominated by sedimentary rock clasts and macrocrysts, microcrysts and macrocryst fragments of silicified serpentinized olivine. It also has a similar crystallinoclastic groundmass dominated by angular to subangular clasts of quartz and feldspar. Autoliths comprise less than 2% of the thin section volume and lapilli are rare. Carbonate rocks are most prevalent in the xenolith population, and these include argillaceous limestone, microcrystalline limestone, biotite bearing arenaceous limestone, and argillaceous limestone self pebble conglomerate. Also present are calcareous shale and siltstone. Autoliths are exclusively Type 3A and most are small (< 2mm across), well rounded, and commonly cored by silicified serpentinized olivine or phlogopite macrocrysts. However, one autolith includes a small macrocryst (0.55mm long) of diopside that is extensively altered to biotite, quartz, amphibole and magnetite. As with most Type 3A autoliths, phlogopite is relatively abundant both as microcrysts and groundmass laths. The matrix is enriched in altered opaque oxides and perovskite, and contains abundant carbonatized microphenocrysts and tiny microcrysts of serpentinized olivine set in a mesostasis of carbonate and variable amounts of cryptocrystalline serpentine and/or quartz.

Phlogopite macrocrysts are relatively common in this sample, and most are subangular to subrounded and range to in excess of 2mm. A single macrocryst (~ 1.12mm across) of garnet with a thin (~ 0.1mm wide), well developed kelyphitic rim is present. The kelyphitic rim is in turn partially rimmed by a thin (~ 0.02mm wide) border of an opaque mineral that is probably titanomagnetite. This garnet grain is partially mantled by Type 3A autolithic kimberlite. As with Sample R-18, this sample might best be designated as a **weakly foliated, variably carbonatized, autolith bearing, silicified serpentinized olivine macrocryst/microcryst/macrocryst fragment-rich, crystallinoclastic, diatreme facies kimberlite lithic breccia, with a garnet macrocryst.**

R-20 (110.20 m, oversize) This is a badly disrupted thin section and appears to have been ground down too much. However the material is essentially the same as that in Sample R-19. As with the previous sample, autoliths are exclusively Type 3A, comprise only a small portion of the total rock volume, and both cored and non-cored varieties occur in nearly equal proportion. All are characterized by the presence of appreciable phlogopite, both microcrystic and groundmass laths, and are relatively enriched in opaque oxides and perovskite. The largest autolith in the sample is about 4.8mm long and is cored by a 3.2mm long subrounded fragment of kerogen (?) rich, microcrystalline limestone. Like Sample R-19, this sample also is best referred to as a **weakly foliated, variably carbonatized, autolith bearing, silicified serpentinized olivine macrocryst/microcryst/macrocryst fragment-rich, crystallinoclastic, diatreme facies kimberlite lithic breccia.**

110.20 metres This sample also is dominated by sedimentary rock xenoliths and macrocrysts, microcrysts and macrocryst fragments of silicified serpentinized olivine. However, it is slightly more enriched in autoliths than the previous two samples (~ 2-3% by volume). Sedimentary rock fragments are similar to those in the previously described samples; however, several clasts of kerogen rich arenaceous shale contain fossil cellular material (bone or wood), in which cell openings are filled with microcrystalline to cryptocrystalline quartz. The autoliths are primarily Type 3A, are typically rounded to subrounded, commonly elongate, and are compositionally similar to those in previously described 110.2 metre level samples. Many are cored by silicified serpentinized olivine macrocrysts, and the largest autolith (~ 2.0 x 2.0mm) exhibits a strong alignment of macrocrysts and microcrysts of phlogopite and silicified serpentinized olivine indicating a pronounced flow regime during crystallization of this hypabyssal kimberlite. Two Type 3 autoliths that are typically highly enriched in opaque oxides and perövskite also are present. This sample also contains several grains of dark orange brown and pale brown spinel (up to 1.1mm across), and a single grain (~ 1.12mm across) of moderately kelyphitized garnet. Several small grains (< 0.5mm) of subrounded ilmenite with ragged reaction borders also are present. This sample might best be designated a **weakly foliated, variably carbonatized, autolith bearing, silicified serpentinized olivine macrocryst/microcryst/macrocryst fragment-rich, crystallinoclastic, diatreme facies kimberlite lithic breccia, with an extensively kelyphitized garnet macrocryst.**

137.46 Metre Interval

137.46 metres The single sample from the 137.46 metre level is a weakly pyritic, locally conglomeratic (primarily self-pebble), fine grained, calcareous sandy mudstone. Sand and silt grains of quartz and minor feldspar are mostly angular to subangular, but several irregular zones of intercalated mudstone contain somewhat coarser and more rounded grains. Minor small grains of biotite and zircon also are present. Rounded to subrounded pebbles of mudstone and lesser shale and carbonate are locally abundant, and range to 6mm. Although the groundmass of this rock may originally have been primarily clay, it is now essentially all finely crystalline carbonate. The thin section is cut locally by thin (most < 0.3 mm wide) veinlets of calcite. The sand and silt size grains of quartz and feldspar in this rock are identical to those in the groundmass of the 110.2 metre level crystallinoclastic kimberlite breccia. The latter likely were derived from disaggregation of similar source rocks. Although this sample may be from a block of wallrock within the Ram-6 pipe, it also might indicate that the drill hole has passed through the kimberlite-wallrock contact. This rock is probably best referred to as a **weakly pyritic, fine grained, calcareous arenaceous mudstone, with included pebbles of limestone and calcareous shale and mudstone.**

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Statement of Qualifications

I, Malcolm E. McCallum, a U.S. citizen and consulting geologist, do hereby certify that:

1. I am a Professor Emeritus of Geology and Research Geologist at Colorado State University, Fort Collins, CO, where I was involved from 1962 through 1995 in minerals exploration related teaching and research. I served as thesis advisor to more that 60 graduate students.

2. I retired from the teaching faculty of Colorado State in 1995 to devote more time to minerals exploration consulting, but am still affiliated with the University as a senior research scientist.

3. I am a co-founder of HDM Laboratories Inc. (1302 East First Street, Loveland, CO, 80537) which specializes in diamond and gold exploration sample processing and evaluation.

4. I am a graduate of Middlebury College, The University of Tennessee, and the University of Wyoming with an A.B., M.S., and Ph.D. respectively in Geology.

5. I am a fellow of the Geological Society of America, the Society of Exploration Geochemists, the Society of Economic Geologists, and the Mineralogical Society of America.

6. I was employed as a part time (WAE) field research geologist with the U.S. Geological Survey from 1956 through 1984, with an emphasis on minerals evaluation of Precambrian crystalline rocks.

7. I have been a part time consulting geologist for minerals exploration companies since 1985, and have practiced in the United States, Canada, South America, Africa and Europe.

8. I have been involved in kimberlite and diamond related research and exploration since 1964, and was a major participant in the discovery of a number of diamondiferous kimberlites in Colorado, Wyoming, Venezuela, and the NWT and B.C., Canada.

9. This report and its conclusions are based on my own observations of the studied materials, and on experience over many years evaluating similar materials.

10. I have not received, nor do I expect to receive, any direct or indirect interest in Skeena Resources Ltd., nor any of its corporate partners or associates, and

11. I do not have any direct or indirect interest in any properties, interests or holding of Skeena Resources Ltd., nor any of its corporate partners or associates.

Loveland, CO, USA
April 2002

M.E. McCallum

Robin Chisholm

From: <MEMcCallum@aol.com>
To: <robinc@taiga-ltd.com>
Sent: April 24, 2002 11:37 PM
Subject: Re: response to autoliths

Robin,

The surface has literally just been scratched at Elkford. Based on available information, none of the tested pipes appears likely to be a producers; however, considerable very promising results such as reasonably good indicator mineral chemistry and presence of diamonds certainly warrants more work in the area. As I mentioned to Rupert when I spoke with him a few days ago, the critical thing now is to locate more pipes and get them tested. Even though most of the "experts" have maintained in recent years that no diatreme in the Rocky Mountains has any chance of being economic (off craton and rootless), not too many years ago these same "experts" were stating that there "is no chance of either kimberlite or diamonds occurring in this region." As you have suggested, that statement speaks for itself. I have often wondered how these "experts" know just where the western edge of the craton is located. Furthermore, if a rootless pipe is truncated at several thousand metres below surface, it would appear to me that more than adequate tonnage would be available if grade and stone quality were appropriate. Also remember it wasn't that long ago when De Beers walked away from the Argyle pipe in western Australia because the "non-kimberlitic material in the pipe could not be the source of the surface diamonds" Does provide lots of food for thought, doesn't it. Clearly, more work needs to and should be done in the area.

Regarding your question on how I would be so audacious as to suggest that nodules such as the spinel lherzolite in sample #20 are derived from the upper mantle; that supposition is based on apparent composition of the spinel. Only a chemical analysis would verify my inference, but the pale brown to reddish brown colour of the spinel generally indicates a lower Cr higher Al content which is fairly typical of shallower mantle sources. Deeper mantle source spinels are Cr rich Al poor chromites that are characteristically opaque. Pyrope is a common associate of the deeper mantle spinels in garnet lherzolites, but does not occur as a normal constituent in upper mantle spinel lherzolites.

I trust you are well along with your report by now, but if you have any further questions give a shout.

Best regards,
Mac

Robin Chisholm

From: <MEMcCallum@aol.com>
To: <robinc@taiga-ltd.com>
Sent: April 23, 2002 12:24 AM
Subject: Autoliths

Hello Robin,

Sorry about the brain Novocain, but just imagine what it did to me. However, as I mentioned before, it just seems that once that thin section is under the microscope I tend to get carried away. Addictive, I guess. Regarding the autoliths and possible diamond content--my principal comment was related more to the fact that the autolith rich Bonus pipe has a much higher kimberlite content than the drilled part of the Ram-6 which is high in wallrock material. To my knowledge, the presence or absence of autoliths has no particular bearing on the possible diamond content of a pipe, unless the autoliths are diamondiferous. However, they do indicate compositional variations of earlier crystallized kimberlite phases, and, of course, some of these could have been diamond bearing. If any of your "kimberlite cognoscenti" were suggesting to you that the presence of autoliths in a kimberlite would diminish its potential for diamonds, that is completely without basis. Some of the finest nucleated autoliths I have ever seen were from the Finch pipe in South Africa, and that certainly has been a rather good producer over the years. Furthermore, the Bonus kimberlite is rather similar to samples I have from a number of diamond bearing pipes throughout the world, but I certainly could not determine the prospectivity of any of the sources from just a glance at the samples. Your quick conclusion observers apparently utilize a BSS approach in which one determines the diamond potential of the kimberlite on the basis of where it is from. You are right on target with your statement that a quick visual examination will not go far in determining an intrusion's diamond potential. If this were the case, why do we spend so much money on caustic fusion analyses and bulk tests!!!

Good luck with your report, and give a shout if you have other questions. Sorry if I misled you regarding the possible value of autoliths in assessing diamond potential of a given pipe. Again, I was merely stressing that the odds are better where there is more kimberlite, autoliths or not.

Cheers,
Mac

ASHTON MINING
OF CANADA INC.

DENSE MEDIA SEPARATION PLANT PROCESSING OF A 4.0 TONNE MINI-BULK SAMPLE FOR DIAMOND RECOVERY

V0202-001

Ashton Mining of Canada Inc.
Vancouver Laboratory

Prepared For:

Skeena Resources Ltd.
#406-675 West Hastings Street
Vancouver, BC
V6B 1N2

Jeff Brendon,
Laboratory Manager
Ashton Mining of Canada Inc.
February 11, 2002

UNIT 123-930 WEST 1ST STREET NORTH VANCOUVER B.C. CANADA V7P 3N4 TEL 604/983-7750 FAX 604/987-7107

ASHTON MINING
OF CANADA INC.

LABORATORY REPORT: V0202-001 **DATE: February 11, 2002**

Project:	**Dense Media Separation (DMS) Plant Processing Of a Mini-Bulk Sample for Diamond Recovery**
Submitted By:	**Rupert Allan, Skeena Resources Ltd.**
Sample Number:	**10941, 10942, 10943**
Sample Type:	**Surface Rock, 3827 kilograms**
Date Received:	**January 11, 2002**
Report By:	**Jeff Brendon**

1.0 Introduction:

A mini-bulk sample of boulder-sized surface rock was received from Skeena Resources Ltd. on January 11th, 2002 for dense media separation (DMS) plant processing. The mini-bulk sample had a net weight of 3827 kilograms, and was received at the North Vancouver laboratory of Ashton Mining of Canada Inc. in 6 bulk ore bags on pallets.

The mini-bulk sample was divided into three separate sub-samples of approximately 1300 kilograms each for easier batch processing through the DMS plant. The three sub-samples, designated sample numbers 10941, 10942 and 10943, were processed for diamond recovery through the Bateman/Van Eck & Lurie one tonne per hour (1 tph) dense media separation plant of Ashton Mining between January 15th and 21st, 2002. Diamond recovery, in the +0.5-6.0 mm size range, was conducted on the DMS plant concentrates, using specialized microscopy techniques and hand sorting for diamonds, in the Observing Laboratory between February 6th and 8th, 2002.

This report details the methodology and includes the data sheets employed during the analysis. Final diamond results are reported on the Certificate of Analysis attached as page 5 of this report.

UNIT 123-930 WEST 1ST STREET NORTH VANCOUVER B.C. CANADA V7P 3N4 TEL 604/983-7750 FAX 604/987-7107

2.0 Dense Media Separation Plant Processing Methodology:

The DMS mini-bulk sample was initially disaggregated using a Kango electric jackhammer to break the boulders into less than 125 x 125 mm pieces prior to feeding the Whitelaw 5" x 8" jaw crusher. The material was then jaw crushed at 10.0 mm, then processed through secondary roll crushing at a nominal gap of 8.0 mm. Dry, crushed product was then fed into the scrubber-trommel unit of the ore-prep circuit for desliming, where the trommel screens removed the +6.0 mm oversize for re-crushing. The –6.0 mm scrubber discharge was introduced onto a vibrating desliming screen deck, fitted with 0.50 mm square mesh aperture screens. The –0.50 mm fines portion was fed to tailings containment, and the +0.50-6.0 mm feed was slurry pumped to the feed preparation screen deck feeding the DMS module. The feed preparation screen deck was fitted with 0.50 mm square aperture stainless steel screens, and served as a de-watering stage prior to the sample (+0.5-6.0 mm) being introduced to the ferrosilicon (FeSi) slurry at the mixing box of the plant.

All tailings from the first pass through the plant were subsequently re-crushed at 6.0 mm, then 4.0 mm, re-passed through the DMS, and second pass tailings were then crushed at 2.0 mm. The 2.0 mm material was run through the plant for a third and final pass. In this way, all material was processed on a three-pass system, at 6.0, 4.0 and 2.0 mm, and this system of iterative crushing and re-processing is designed to minimize the potential for diamond breakage and still effectively liberate all diamonds down to 0.5 mm in size.

The 100 mm cyclone fitted to the DMS plant can effect a density separation for grain sizes in the +0.5 – 6.0 mm size range with >98% efficiency. Only diamonds greater than 0.5 mm in two dimensions, as defined by the square mesh aperture screens, are routinely reported.

The DMS plant is run with a slurry density of 2.75 g/mL as measured by the Marcy Scale for pulp density, which produces an effective cut-point of 2.95 to 3.00 g/mL. This cut-point thereby ensures that all diamonds (diamond density = 3.52 g/mL) routinely report to the sinks (concentrate) portion after cyclone separation. All concentrates are labeled and placed in a locked oven to dry at the completion of each working shift.

Due to the comparatively low effective cut-point of the DMS cyclone, some degree of post-processing of the concentrates was required prior to diamond recovery. Concentrates were dried, and then screened at 0.8, 1.0, 2.0, and 4.0 mm. The +4.0-6.0 mm fraction was sent for observation without additional treatment. The +0.5-0.8 mm, +0.8-1.0 mm, +1.0-2.0 mm, and +2.0-4.0 mm fractions were treated through a series of heavy liquid separations, first at density 2.96 g/mL, then at 3.32 g/ml, prior to observation of the concentrates. No additional post-processing of the concentrates was conducted and no magnetic separation techniques were required.

2.1 Concentrate Observation & Diamond Recovery:

Recovery of diamonds in the resulting +4.0-6.0 mm concentrate was done by macroscopic hand sort, and recovery of diamonds in the +0.5-0.8 mm, +0.8-1.0 mm, +1.0-2.0 mm, and +2.0-4.0 mm fractions of the concentrates was conducted by binocular microscopy methods.

All observed concentrates were subjected to a two-pass observation by two different people, with select portions receiving a third pass check as warranted. Any potential diamonds recovered are routinely picked, verified and isolated from the samples. Diamonds are reported in terms of size, colour, morphology, and where possible, weighed. Dr. Tom McCandless, Chief Mineralogist, verifies all recovered diamonds as such, and Mr. Volodymyr Zhuk, Laboratory Process Geologist, Quality Control Specialist, is responsible for ensuring that quality control procedures are maintained throughout the entire process.

3.0 Additional Notes:

- All samples concentrates have been returned with this report. A total of 33.2 kilograms of concentrate was produced, which was further reduced to 1.12 kilograms of final observable concentrate through a heavy liquid separation at density 3.32 g/mL. Concentrate bags identified as "d > 3.32" represent the final observed portions where all material has density $\geq$ 3.32 g/mL. Concentrate bags identified as "d < 2.96" or "2.96 < d <3.32" represent non-observed portions where all material has density $\geq$ 2.96 and $\leq$ 3.32 g/mL.

- Quality control testing was conducted by the addition of 3 known diamond "spikes" in the +1.0-2.0 mm and +2.0-4.0 mm size ranges, added without operator knowledge during DMS plant processing. Recovery was measured at the observing stage and results revealed 100% recovery. A second quality control test involved the addition of 10 density tracers with density = 3.5 g/mL, added during the sample processing. Recovery was measured at the observing stage and results revealed 100% recovery. All results and the positive identification of the diamond spikes was verified by Volodymyr Zhuk, Quality Control Specialist, on February 8^{th}, 2002.

- Final granulometry tests conducted on the tailings revealed 95% and 97% (2 tests) of material was less than 2.0 mm prior to disposal.

- Two samples of approximately 5 kilograms each were retained for possible QC audit purposes. Both samples were retained in their entirety for reference.

ASHTON MINING OF CANADA INC.

Vancouver Laboratory
#123-930 West First Street, North Vancouver, BC, V7P 3N4
Telephone (604) 983-7750 Facsimile (604) 987-7107

CERTIFICATE OF ANALYSIS
DMS PLANT DIAMOND RECOVERY RESULTS

Project:	Skeena Resources Ltd. #406-675 West Hastings Street Vancouver, BC, V6B 1N2	**Date Received:**	11-Jan-02
		Waybill No:	720983
		File No:	V0202-001
Contact:	Rupert Allan (604) 684-8725 Fax (604) 682-0531	**Lab Billing Code:**	15EX08
		Observation Date:	08-Feb-02

Sample Number	Diamond Mesh Size	No. of Stones	Dimensions (mm)			Weight (carats)	Morphology/Description	Colour	Clarity	Resorption	Whole/ Fragment?	Other Comments
			x	y	z							
10941	+4.0-6.0 mm	0										
1309.8 kg	+2.0-4.0 mm	0										
	+1.0-2.0 mm	0										
	+0.8-1.0 mm	0										
	+0.5-0.8 mm	0										
	Total	**0**				**0.0000**						
10942	+4.0-6.0 mm	0										
1140.5 kg	+2.0-4.0 mm	0										
	+1.0-2.0 mm	0										
	+0.8-1.0 mm	0										
	+0.5-0.8 mm	0										
	Total	**0**				**0.0000**						

Dr. Tom McCandless
Chief Mineralogist

Jeff Brendon
Laboratory Manager

Volodymyr Zhuk
Quality Control Specialist

The procedures for diamond recovery from DMS plant processing are governed by strict quality assurance/quality control (QA/QC) standards at all stages of processing, observation and reporting. Quality control recoveries are measured through the addition of known diamond "spikes" at various stages of processing with recovery measured at the observation stage. Continual QA/QC monitoring and a variety of internal & external audits ensures that statistically acceptable internal performance standards are consistently met or exceeded.

ASHTON MINING OF CANADA INC.

Vancouver Laboratory

#123-930 West First Street, North Vancouver, BC, V7P 3N4

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CERTIFICATE OF ANALYSIS
DMS PLANT DIAMOND RECOVERY RESULTS

Project: Skeena Resources Ltd.
#406-675 West Hastings Street
Vancouver, BC, V6B 1N2

Contact: Rupert Allan
(604) 684-8725 Fax (604) 682-0531

Date Received: 11-Jan-02
Waybill No: 720983
File No: V0202-001
Lab Billing Code: 15EX08
Observation Date: 08-Feb-02

Sample Number	Diamond Mesh Size	No. of Stones	Dimensions (mm)			Weight (carats)	Morphology/Description	Colour	Clarity	Resorption	Whole/ Fragment?	Other Comments
			x	y	z							
10943	+4.0-6.0 mm	0										
1377.0 kg	+2.0-4.0 mm	0										
	+1.0-2.0 mm	0										
	+0.8-1.0 mm	0										
	+0.5-0.8 mm	0										
	Total	0				0.0000						

Dr. Tom McCandless
Chief Mineralogist

Jeff Brendon
Laboratory Manager

Volodymyr Zhuk
Quality Control Specialist

The procedures for diamond recovery from DMS plant processing are governed by strict quality assurance/quality control (QA/QC) standards at all stages of processing, observation and reporting. Quality control recoveries are measured through the addition of known diamond "spikes" at various stages of processing with recovery measured at the observation stage. Continual QA/QC monitoring and a variety of internal & external audits ensures that statistically acceptable internal performance standards are consistently met or exceeded.

Appendix I:

DMS Plant Data Sheets

ASHTON MINING OF CANADA LABORATORY: PROCESSING DMS CONCENTRATE DATA SHEET

Sample No: 10941

Date: from Jan 22 to Jan 25/02

Sample Type: DMS Conc.

Wt. Initial: 9.87 kg ~~(g)~~

Wt. to Observation: 403.0 (g)

DMS Concentrate	6.0 mm pass	4.0 mm pass	2.0 mm pass	Total
Concentrate Weight (g)	←	combined	→	9868.4
%				100%

Dry Screen	Size Fraction				
	+4.0 -6.0 mm	+2.0 -4.0 mm	+1.0 -2.0 mm	+0.8 -1.0 mm	-0.8 +0.5 mm
Weight (g)	1412.4	4780.1	2425.2	854.8	401.2
Total Wt. (g)	9873.7				

Size Fraction	Non-Mags g	TBE Sinks d ≥ 2.96 (g)	MI Sinks d ≥ 3.32 (g)		Conc. Wt. to Observation
+4.0-6.0 mm	Not Done	67.6	n/a	→	67.6
+2.0-4.0 mm	Not Done	189.1	n/a	→	189.1
+1.0-2.0 mm	Not Done	171.8	41.4	→	41.4
+0.8-1.0 mm	Not Done	103.2	44.6	→	44.6
+0.5-0.8 mm	Not Done	93.7	60.3	→	60.3
Total					403.0

Size Fraction	Paramags g	Dry Mill g	MI Sinks g	Other g	Conc. Wt. to Observation
+4.0-6.0 mm					
+2.0-4.0 mm					
+1.0-2.0 mm					
+0.8-1.0 mm					
+0.5-0.8 mm					
Total					

Operators/Dates: Jan 22 - JB / Jan 23 - 25 - APH + SJ.

Comments:

u:\jbrendon\documents2000\LabMethods\DMS\DMS Conc Datasheet-Nov00.xls

ASHTON MINING OF CANADA LABORATORY: PROCESSING DMS CONCENTRATE DATA SHEET

Sample No: 10942   Date: from Jan 22 to Jan 25/02

Sample Type: DMS Conc.   Wt. Initial: 13.4 kg ~~(g)~~

Wt. to Observation: 330.1 (g)

DMS Concentrate	6.0 mm pass	4.0 mm pass	2.0 mm pass	Total
Concentrate Weight (g)	←	combined	→	13417.6
%				100%

Dry Screen	Size Fraction				
	+4.0 -6.0 mm	+2.0 -4.0 mm	+1.0 -2.0 mm	+0.8 -1.0 mm	-0.8 +0.5 mm
Weight (g)	1731.7	6392.6	3578.6	1172.1	481.3
Total Wt. (g)	13356.3				

Size Fraction	Non-Mags g	TBE Sinks d ≥ 2.96 (g)	MI Sinks d ≥ 3.32 (g)		Conc. Wt. to Observation
+4.0-6.0 mm	Not Done	42.1	n/a	→	42.1
+2.0-4.0 mm	Not Done	150.7	n/a	→	150.7
+1.0-2.0 mm	Not Done	158.2	40.1	→	40.1
+0.8-1.0 mm	Not Done	108.5	43.1	→	43.1
+0.5-0.8 mm	Not Done	86.8	54.1	→	54.1
Total					330.1

Size Fraction	Paramags g	Dry Mill g	MI Sinks g	Other g	Conc. Wt. to Observation
+4.0-6.0 mm					
+2.0-4.0 mm					
+1.0-2.0 mm					
+0.8-1.0 mm					
+0.5-0.8 mm					
Total					

Operators/Dates: Jan 22 - JB / Jan 23-25 – APH + SJ.

Comments:

ASHTON MINING OF CANADA LABORATORY: PROCESSING DMS CONCENTRATE DATA SHEET

Sample No: 10943

Date: from Jan 22 to Jan 25/02

Sample Type: DMS Conc.

Wt. Initial: 9.9 kg ~~(g)~~

Wt. to Observation: 387.8 (g)

DMS Concentrate	6.0 mm pass	4.0 mm pass	2.0 mm pass	Total
Concentrate Weight (g)	←	combined	→	9989.4
%				100%

Dry Screen	Size Fraction				
	+4.0 -6.0 mm	+2.0 -4.0 mm	+1.0 -2.0 mm	+0.8 -1.0 mm	-0.8 +0.5 mm
Weight (g)	1231.7	4783.0	2661.2	892.4	413.3
Total Wt. (g)	9981.6				

Size Fraction	Non-Mags g	TBE Sinks d ≥ 2.96 (g)	MI Sinks d ≥ 3.32 (g)		Conc. Wt. to Observation
+4.0-6.0 mm	Not Done	49.5	n/a		49.5
+2.0-4.0 mm	Not Done	179.0	n/a		179.0
+1.0-2.0 mm	Not Done	156.7	43.3		43.3
+0.8-1.0 mm	Not Done	109.1	48.6		48.6
+0.5-0.8 mm	Not Done	96.8	67.4		67.4
Total					387.8

Size Fraction	Paramags g	Dry Mill g	MI Sinks g	Other g	Conc. Wt. to Observation
+4.0-6.0 mm					
+2.0-4.0 mm					
+1.0-2.0 mm					
+0.8-1.0 mm					
+0.5-0.8 mm					
Total					

Operators/Dates: Jan 22 – JB / Jan 23-25 – APH + SJ.

Comments:

u:\jbrendon\documents2000\LabMethods\DMS\DMS Conc Datasheet-Nov00.xls

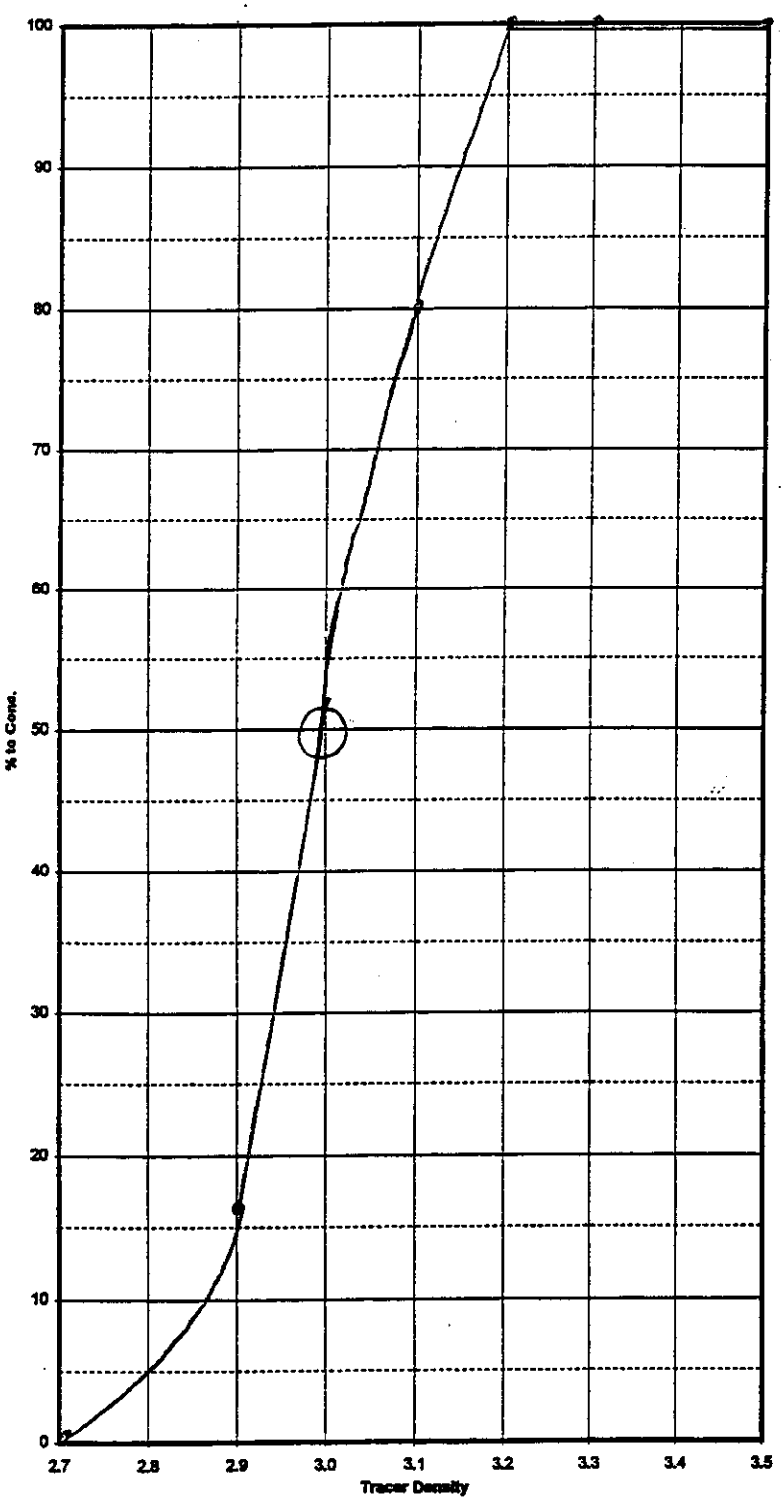
ASHTON MINING OF CANADA INC LABORATORY: DMS DENSITY TRACER TESTS

SAMPLE NUMBER: 10941

SAMPLE WEIGHT: 1309.8 kg

DATE: Jan 16/02

OPERATORS: AH / SJ



DENSITY 11:25 am

at Mixing Box 2.75 g/mL

at Cyclone Discharge ______ g/mL

at Mag Separator ______ g/mL

Machine Pressure 64 kPa

TRACER RESULTS

Colour		Amt	Conc	Lites	% To Conc.
Blue	3.50	50	50	0	100
Blue/green	3.30	50	50	0	100
Violet	3.20	50	50	0	100
Green	3.10	50	40	10	80
Brick Red	3.00	50	26	24	52
Orange	2.90	50	8	42	16
p. blue	2.70	50	0	50	0

Total Recovered of 350 Added: 350

Comments:

Cut Point, D 50% = 2.99

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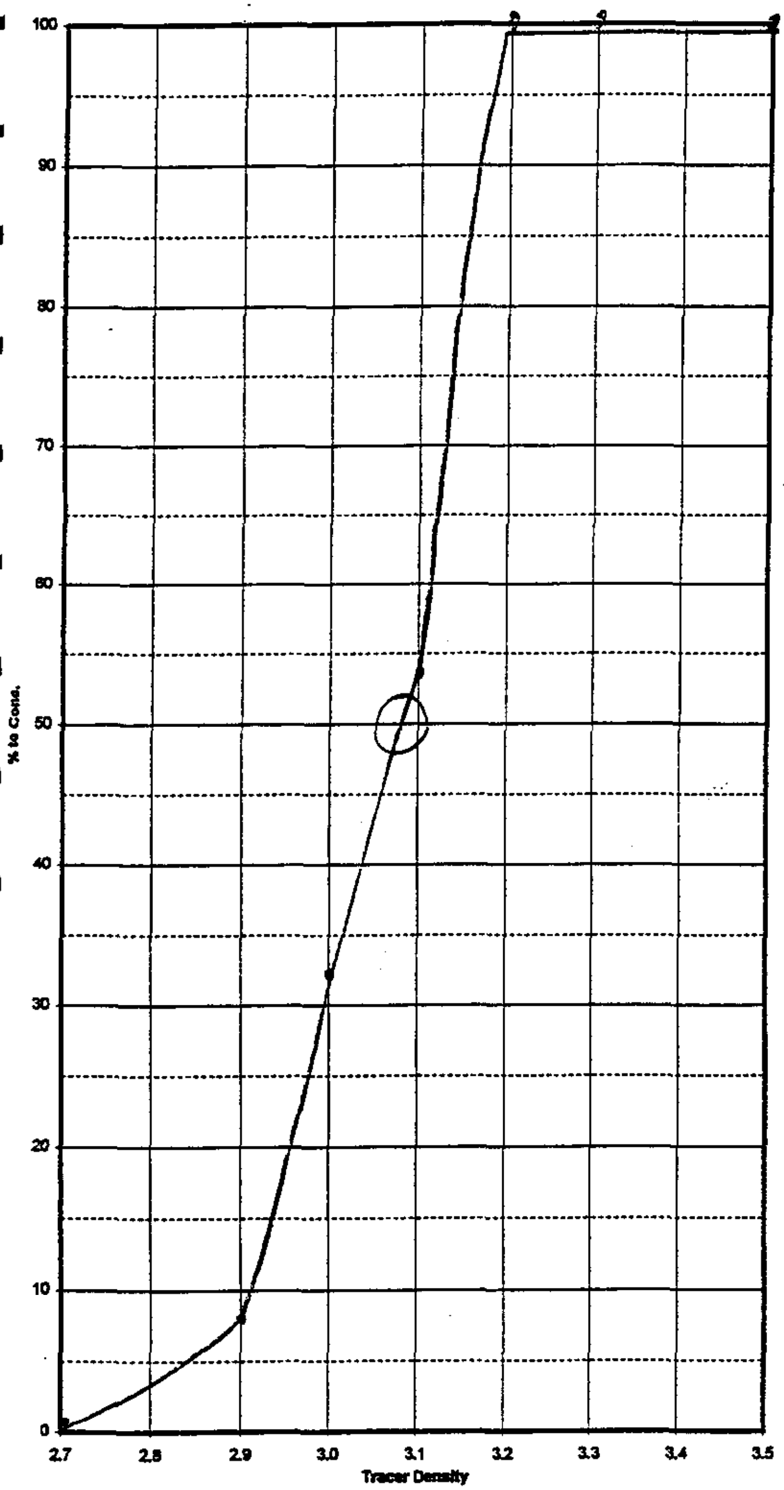
ASHTON MINING OF CANADA INC LABORATORY: DMS DENSITY TRACER TESTS

SAMPLE NUMBER: 10942

DATE: Jan 18/02

SAMPLE WEIGHT: 1140.5 kg

OPERATORS: AH/SJ



DENSITY 7:54 am		
at Mixing Box	2.75	g/mL
at Cyclone Discharge		g/mL
at Mag Separator		g/mL
Machine Pressure	68	kPa

TRACER RESULTS

Colour		Amt	Conc	Lites	% To Conc.
Blue	3.50	50	50	0	100
Blue/green	3.30	50	50	0	100
Violet	3.20	50	50	0	100
Green	3.10	50	27	23	54
Brick Red	3.00	50	16	34	32
Orange	2.90	50	4	46	8
p. blue	2.70	50	0	50	0

Total Recovered of 350 Added: 350

Comments:

Cut Point, $D_{50\%}$ = 3.08

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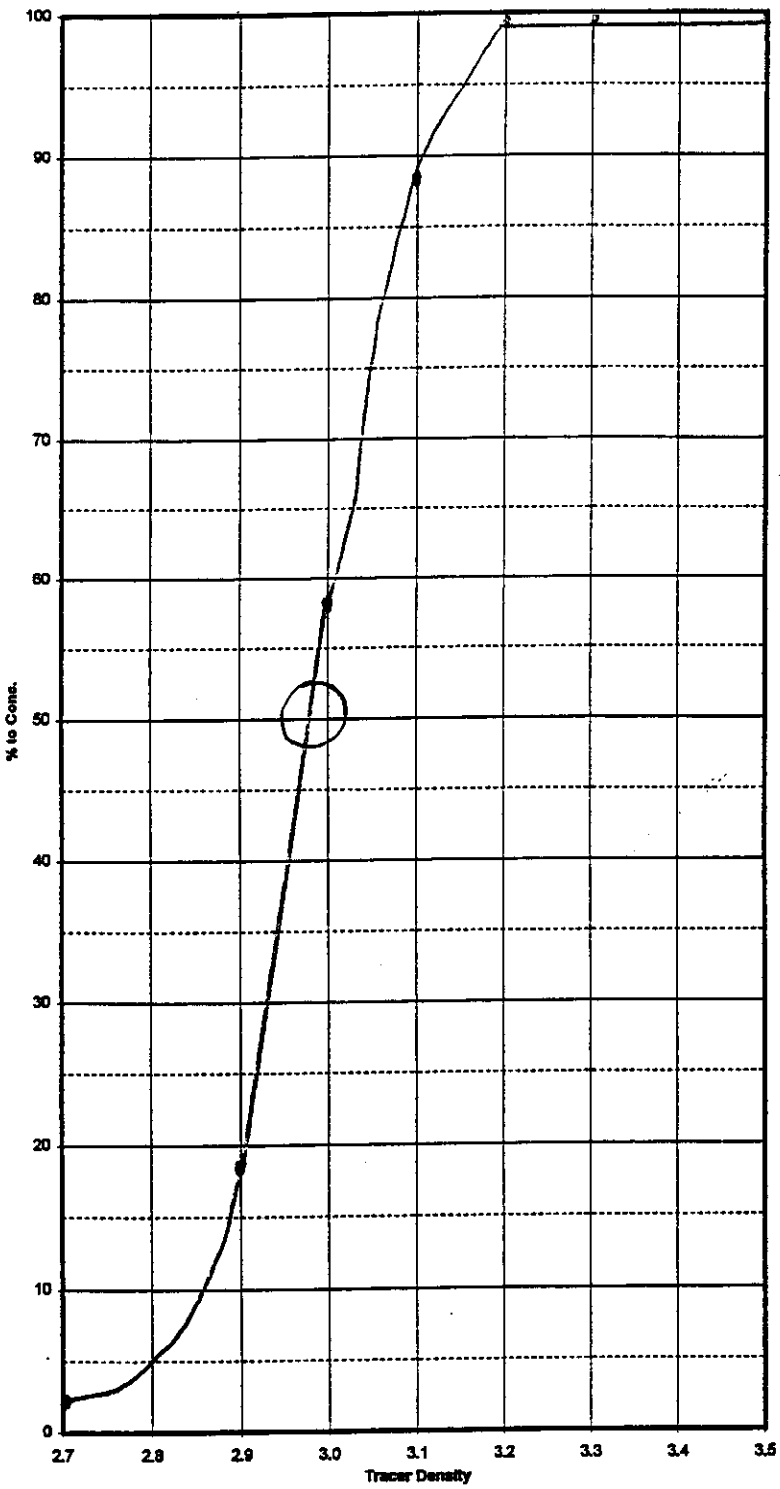
ASHTON MINING OF CANADA INC LABORATORY: DMS DENSITY TRACER TESTS

SAMPLE NUMBER: 10943

SAMPLE WEIGHT: 1377.0 kg

DATE: Jan 22/02

OPERATORS: AH/SJ



DENSITY		
at Mixing Box	2.75	g/mL
at Cyclone Discharge		g/mL
at Mag Separator		g/mL
Machine Pressure	62	kPa

TRACER RESULTS

Colour		Amt	Conc	Lites	% To Conc.
Blue	3.50	50	50	0	100
Blue/green	3.30	50	50	0	100
Violet	3.20	50	50	0	100
Green	3.10	50	44	6	88
Brick Red	3.00	50	39	21	58
Orange	2.90	50	9	41	18
p. blue	2.70	50	1	48	2

Total Recovered of 350 Added: 349

Comments: 1 pale blue tracer not recovered.

Cut Point, $D_{50\%}$ = 2.97

u:\vzhuk\processing\dms-plant\forms\VZ-AMCI-DMS-plant-forms-package-April2001.xls <Tromp-Curve>

Appendix II:

The Agreement

TO → JEFF BRENDON. 5p. DEC. 7/01.

ASHTON MINING
OF CANADA INC.

October 19, 2001

BY FACSIMILE: 604-682-0531
ORIGINAL BY COURIER

Skeena Resources Ltd.
406 – 375 West Hastings Street,
Vancouver, BC,
V6B 1N2

Attention: Mr. Rupert Allan

Dear Mr. Allan,

Re: Quotation for Laboratory Analysis of Kimberlitic Rock Samples for Diamond Recovery by Dense Media Separation (DMS) Plant Methods

This will confirm that you have asked Ashton Mining of Canada Inc. (**"Ashton" or "we" or "us"**) to set out the terms and conditions under which Ashton would be prepared to process a quantity of kimberlitic rock samples for diamond recovery on behalf of Skeena Resources Ltd. (**"Skeena" or "you"**).

As discussed on October 16th, we understand that the rock samples which Skeena wishes to have analyzed are considered to be a single mini-bulk sample with approximate weight of 4.0 tonnes, and will be processed for diamond recovery only through the dense media separation (DMS) plant for the recovery of potentially commercial sized diamonds greater than 0.50 mm (32 Mesh) and nominally less than 6.0 mm in size (1/4 Mesh).

The terms and conditions under which we offer to perform this work are set out in this letter which, once signed by both Ashton and Skeena, will become the **"Agreement"**.

The terms and conditions are as follows:

1.0 Proposed Procedure:

The DMS mini-bulk sample is initially crushed and disaggregated to less than 125 x 125 mm prior to feeding the 5" x 8" jaw crusher. Material is then jaw-crushed at 10.0 mm, then processed through secondary roll crushing at a nominal gap of 6.0 mm. Dry, crushed product is then fed into the scrubber-trommel unit for removal of oversize and undersize material, where the trommel screens remove the +6.0 mm oversize for re-crushing. The –6.0 mm scrubber discharge

Unit 123-930 West 1st Street North Vancouver B.C. Canada V7P 3N4 Tel 604/983-7750 Fax 604/987-7107

falls onto a vibrating desliming screen deck, fitted with 0.50 mm square mesh aperture screens. The –0.50 mm fines portion is fed to tailings containment, and the +0.50-6.0 mm is slurry pumped to the feed preparation screen deck feeding the DMS module. The feed preparation screen deck is fitted with 0.50 mm square aperture stainless steel screens, and serves as a de-watering stage prior to the sample (+0.5-6.0 mm) being introduced to the ferrosilicon (FeSi) slurry at the mixing box of the dense media separation plant.

All tailings from the first pass through the plant are subsequently re-crushed at 4.0 mm, re-passed through the DMS, and second pass tailings are then crushed at 2.0 mm. The 2.0 mm material is run through the plant for a third and final pass. In this way, all material is processed on a three-pass system, at 6.0, 4.0 and 2.0 mm, and this system of iterative crushing and re-processing is designed to minimize the potential for diamond breakage and still effectively liberate all diamonds down to 0.50 mm in size. All tailings from the final 2.0 mm pass will be discarded once granulometry tests confirm that >=95% of the material is less than 2.0 mm.

The 100 mm cyclone fitted to the DMS plant can effect a density separation for grain sizes in the +0.5 – 6.0 *mm size range with* >98% *efficiency. Only diamonds greater than 0.5 mm in two* dimensions (square mesh aperture) will be reported.

The DMS plant is run with a slurry density of 2.75 g/mL as measured by the Marcy Scale for pulp density, which produces an effective cut-point of 2.95 to 3.05 g/mL. This cut-point thereby ensures that all diamonds (diamond density = 3.52 g/mL) will routinely report to the sinks (concentrate) portion after cyclone separation. All concentrates are labeled and placed in a locked oven to dry at the completion of each working shift.

Due to the comparatively low effective cut-point of the DMS cyclone, some degree of post-processing of the concentrates will be required prior to diamond recovery. Concentrates are dried, and then screened at 0.5, 1.0, 2.0, and 4.0 mm. Depending ultimately upon the size of each fraction, a combination of heavy liquid separation, magnetic separation, wet autogenous milling and/or caustic fusion dissolution may be conducted on each concentrate portion to reduce the size of the final observable fraction.

1.1 Concentrate Observation & Diamond Recovery:

Recovery of diamonds in the resulting +4.0-6.0 mm concentrates is done by macroscopic hand sort, and recovery of diamonds in the +0.5-1.0 mm, +1.0-2.0 mm and +2.0-4.0 mm concentrates is conducted by binocular microscopy methods.

All observed concentrates and fusion residues are subjected to a two-pass observation by two different people, with select portions receiving a third pass check as may be warranted. Any potential diamonds recovered are routinely picked, verified and isolated from the samples. Diamonds are reported in terms of size, colour, morphology, and where possible, weighed. Dr. Tom McCandless, Chief Mineralogist, verifies all recovered diamonds as such, and Mr. Volodymyr Zhuk, Laboratory Process Geologist, Quality Control Specialist, is responsible for ensuring that quality control procedures are maintained throughout the entire process.

Upon full completion of the work, all concentrates, fusion residues, remaining sample materials and any recovered diamonds will be returned to Skeena, together with three copies of the final report. The report will set out the number of diamonds recovered, the individual diamond descriptions, triaxial measurements and/or individual weights for each stone.

2.0 Cost Estimate for Mini-Bulk Sample:

The following cost estimate is provided for the DMS plant processing and observation/mineralogical analysis of the as-received mini-bulk sample with estimated weight of 4 tonnes:

Sample Preparation:	
Initial crushing & sample disaggregation:	*1190.00*
Kango Usage:	*150.00*
DMS Plant Charges:	
DMS plant charges including labour:	*9450.00*
Chemicals & Consumables:	*1150.00*
Fuel Charges:	*115.00*
Waste Disposal Fees:	*525.00*
Environmental Fee, tailings analysis	*75.00*
Freight, Courier, Administrative Fees:	*75.00*
Diamond Sorting/Observation/Characterization:	
Post-Processing Concentrate Reduction:	*1175.00*
Observing, Sorting, Microscopy	*4200.00*
Mineralogical Characterization/Analysis	*1225.00*
Quality Assurance/Quality Control:	*220.00*
Supervisory/Reporting/Project Management:	*1950.00*
Total Cost Estimate for 4.0 Tonnes:	**$21,500.00**
Unit Cost, per Tonne:	**$5375.00**

- All prices quoted are in Canadian funds and do not include GST.
- Ashton requires a minimum 50% advance payment prior to project commencement. The balance will be invoiced upon project completion and is due and payable immediately upon delivery of the report.
- Turn-around time is estimated at 4 weeks from date of receipt of signed agreement, advance payment and receipt of all sample materials.

3.0 General Terms and Conditions:

3.1 Ashton's obligation to report on the characteristics of any diamonds recovered from these samples is limited to the reporting obligations set out in this Agreement. Ashton is not otherwise responsible for the determination of origin, quality or value of any diamonds recovered.

3.2 Ashton will maintain as strictly confidential the fact that Ashton is conducting these analyses on behalf of Skeena, and the results of the analyses themselves. Ashton's Laboratory Manager will release results to Skeena's authorized client representative only.

3.3 Any change to the terms and conditions set out in this Agreement will require the written confirmation of both Ashton and Skeena.

3.4 Ashton will conduct the analysis, testing, inspection and investigation of these samples as set out in this letter in accordance with recognized professional analytical standards. However, the aggregate liability of Ashton, and its directors, officers, employees, agents or subcontractors, for any loss or damage which Skeena may suffer on account of any default, negligence, error or omission on Ashton's part shall not exceed the amount payable by Skeena to Ashton under this Agreement.

3.5 Skeena shall be entitled to disclose publicly that Ashton performed the analyses described in the Agreement in a commercial capacity. However, Skeena shall make no other disclosure or representation as to Ashton's relationship to Skeena or to the subject matter of this Agreement, including, without limiting generality, any representation attributed or attributable to Ashton as to any significance, if any, to be attached to the results of the analyses performed under this Agreement.

3.6 This Agreement shall be subject to and interpreted in accordance with the laws prevailing in the province of British Columbia.

If you wish Ashton to perform this work in accordance with the terms and conditions detailed above, please confirm your acceptance by signing in the space provided below and returning a copy of this Agreement to my attention at your earliest convenience.

I look forward to the opportunity of working with you on this project, and should you have any additional questions or concerns, please feel free to contact me at telephone (604) 983-7750 or by facsimile at (604) 987-7107.

Yours truly,

ASHTON MINING OF CANADA INC.

By: ______________________

Jeff Brendon,
Laboratory Manager.

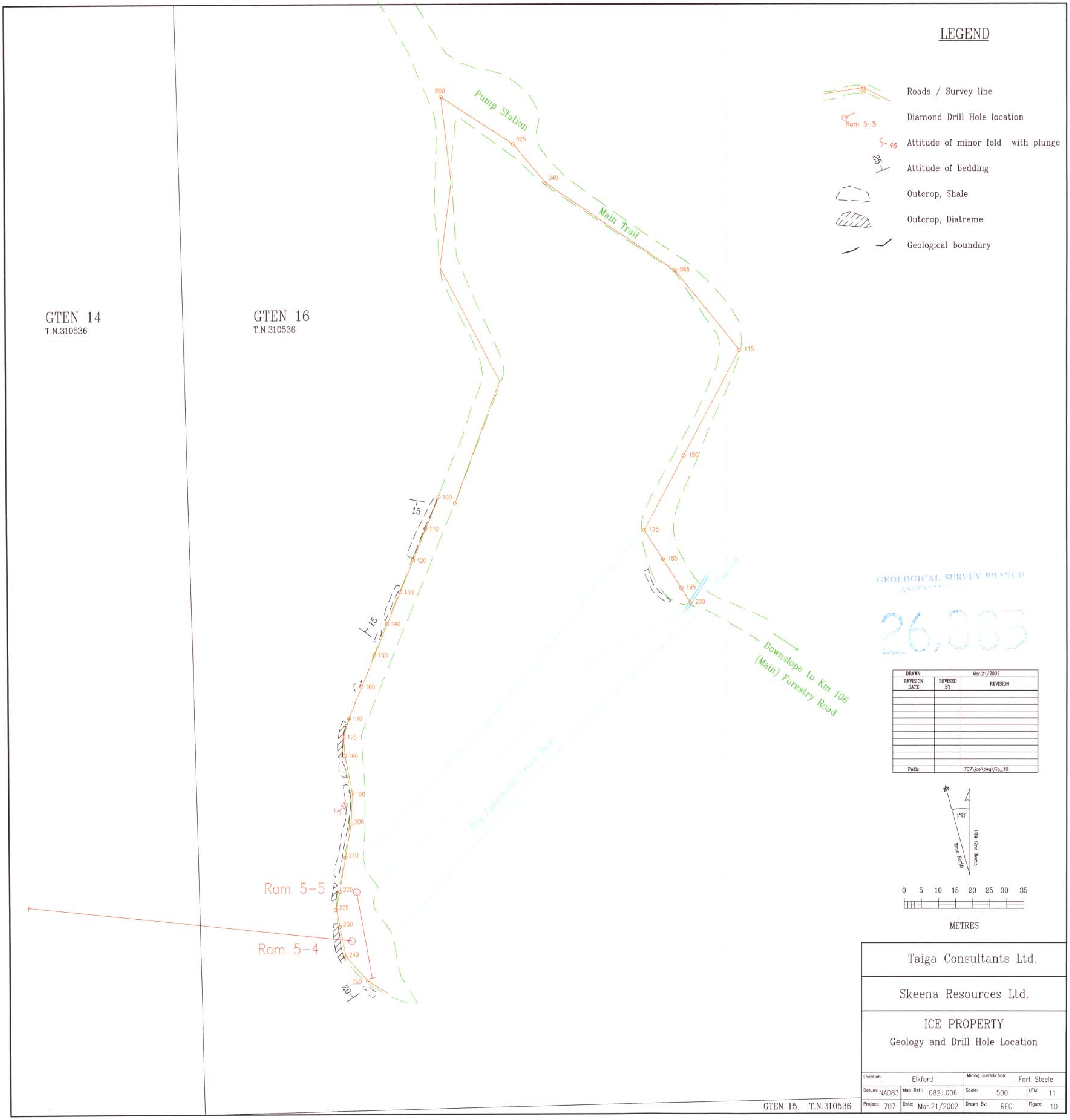
ACKNOWLEDGED, ACCEPTED AND AGREED TO THIS 7th DAY OF ~~OCTOBER,~~ DECEMBER 2001.

SKEENA RESOURCES LTD.

By: ______________________

Rupert Allan,
President & CEO.

Dec 07 01 03:30p SKEENA RESOURCES LTD. (604)682-0331 p.5


LEGEND
Roads / Survey line
Diamond Drill Hole location
Ram 5-5
Attitude of minor fold with plunge
Attitude of bedding
Outcrop, Shale
Outcrop, Diatreme
Geological boundary
GTEN 14
T.N.310536
GTEN 16
T.N.310536
GTEN 15, T.N.310536
Pump Station
Main Trail
Downslope to Km 106
(Main) Forestry Road
Culvert
Ram 5-5
Ram 5-4
000
025
040
085
115
150
175
185
195
200
100
110
120
130
140
150
160
170
175
180
190
200
210
220
225
230
240
250
15
15
20
GEOLOGICAL SURVEY BRANCH
DRAWN: Mar.21/2002
REVISION DATE
REVISED BY
REVISION
Path: 707\ice\dwg\Fig_10
1°21'
True North
UTM Grid North
0 5 10 15 20 25 30 35
METRES
Taiga Consultants Ltd.
Skeena Resources Ltd.
ICE PROPERTY
Geology and Drill Hole Location
Location: Elkford
Mining Jurisdiction: Fort Steele
Datum: NAD83
Map Ref.: 082J.006
Scale: 500
UTM: 11
Project: 707
Date: Mar.21/2002
Drawn By: REC
Figure: 10