12TH INTERNATIONAL KIMBERLITE CONFERENCE

30 YEARS OF DIAMONDS IN CANADA

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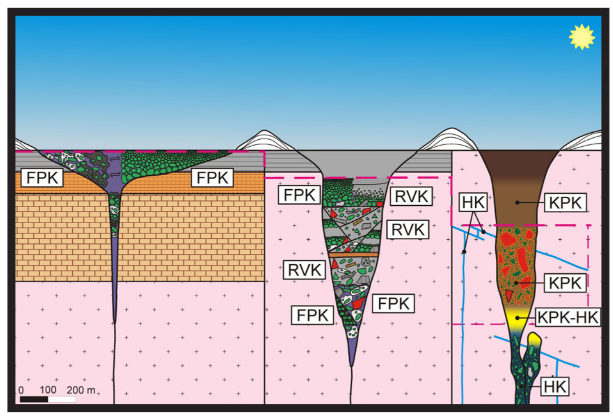
12 IKC FIELD TRIP GUIDE



Northwest Territories Kimberlite Drill Core Collection

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(Northwest Territories Geological Survey)

FT 04

Overview of Canadian Kimberlites

Hundreds of kimberlites have been found across Canada during the '30 Years of Diamonds in Canada'. Before 1985 only about 50 kimberlites were known. In 1988-1989 approximately one hundred kimberlites were discovered south of the 60th parallel at Attawapiskat, Ontario including the Victor Mine (2008-2023) and at Fort à la Corne, Saskatchewan, including advanced evaluation on two pipes.

In 1991 the historic announcement by BHP and Dia Met Minerals of a new kimberlite discovery containing diamonds in the Northwest Territories led to the largest staking rush in Canadian history. Hundreds more kimberlites were found, many north of the 60th parallel, with the current total at 1,077, as shown in **Figure 1** (map and data courtesy of De Beers Group).

Since Canada's first diamond mine (Ekati) commenced production in 1998, Canada has joined the ranks of the great diamond producing countries by becoming the third largest producer of diamonds by value after Botswana and Russia. Three mines remain in operation: Ekati (Burgundy Diamond Mines), Diavik (Rio Tinto) and Gahcho Kué (De Beers / Mountain Province Diamonds).

Figure 2 summarises kimberlite pipe shapes, pipe infills and geological setting across Canada reconstructed to the time of emplacement. This shows that contrasting types of pipe infill correlate with the competency of the country rock into which they were emplaced. FPKs occur in mainly sedimentary rock (localities A, B and F) and the pipe shape reflects the degree of lithification or competency of the sediments. Where poorly consolidated shale overlies competent basement more common RFPK is observed (locality C). Kimberlites emplaced into only basement occur as KPK and HK (localities D, E).

A schematic representation of the detailed geology of the three main types of kimberlite pipes in Figure 2 is presented in **Figure 3**. The FPKs comprise light green commonly fresh olivine occurring either as discrete olivine pyrocrysts or within the fluidal commonly amoeboid-shaped magmaclasts (or FPK-type melt-bearing pyroclasts). The groundmass in the magmaclasts is composed of isotropic serpentine (dark grey) and/or cryptocrystalline carbonate (stippled white). The interclast cement is composed of serpentine and less common carbonate (purple background). Clast-supported textures, normal grading, low proportions of country rock xenoliths and an overall paucity of fine constituents are typical indicating widespread subaerial sorting during pyroclastic eruptions.

The RFPKs in the centre pipe of Figure 3 are composed of variable mixtures of commonly fresh, frequently angular, olivine pyrocrysts (green), xenoliths of the overlying poorly consolidated shale, minor xenoliths of basement (red), minor magmaclasts and wood (brown) set in a matrix of mixed disaggregated shale (paler grey). Bedding and matrix-supported textures are common. Pipe infill resedimentation processes appear to be more commonly subaerial than subaqueous.

The KPKs form pipe-infill overlying an irregular root zone of HK (dark blue) with relatively common HK sheets (paler blue lines) occurring in the vicinity. The HK is composed of olivines (green) set in a fine-grained but well-crystallised groundmass (dark blue). Sub-rounded and partly-digested basement xenoliths are in low abundance (pale grey). In contrast, the KPK contains totally pseudomorphed olivine (darker green) and abundant, angular, fresh basement xenoliths (red). Most of these constituents have thin, extremely fine-grained groundmass selvages (orange) and are termed magmaclasts. The inter-magmaclast matrix (brown) is dominated by serpentine which is commonly weathered to brown clay minerals. There is a gradational textural transition between the HK and KPK (yellow) with increasing xenolith abundance and size, olivine replacement and decreasing degree of crystallinity and xenolith reaction. These rock types are massive with no sorting or bedding indicating they have formed by subsurface magmatic processes.

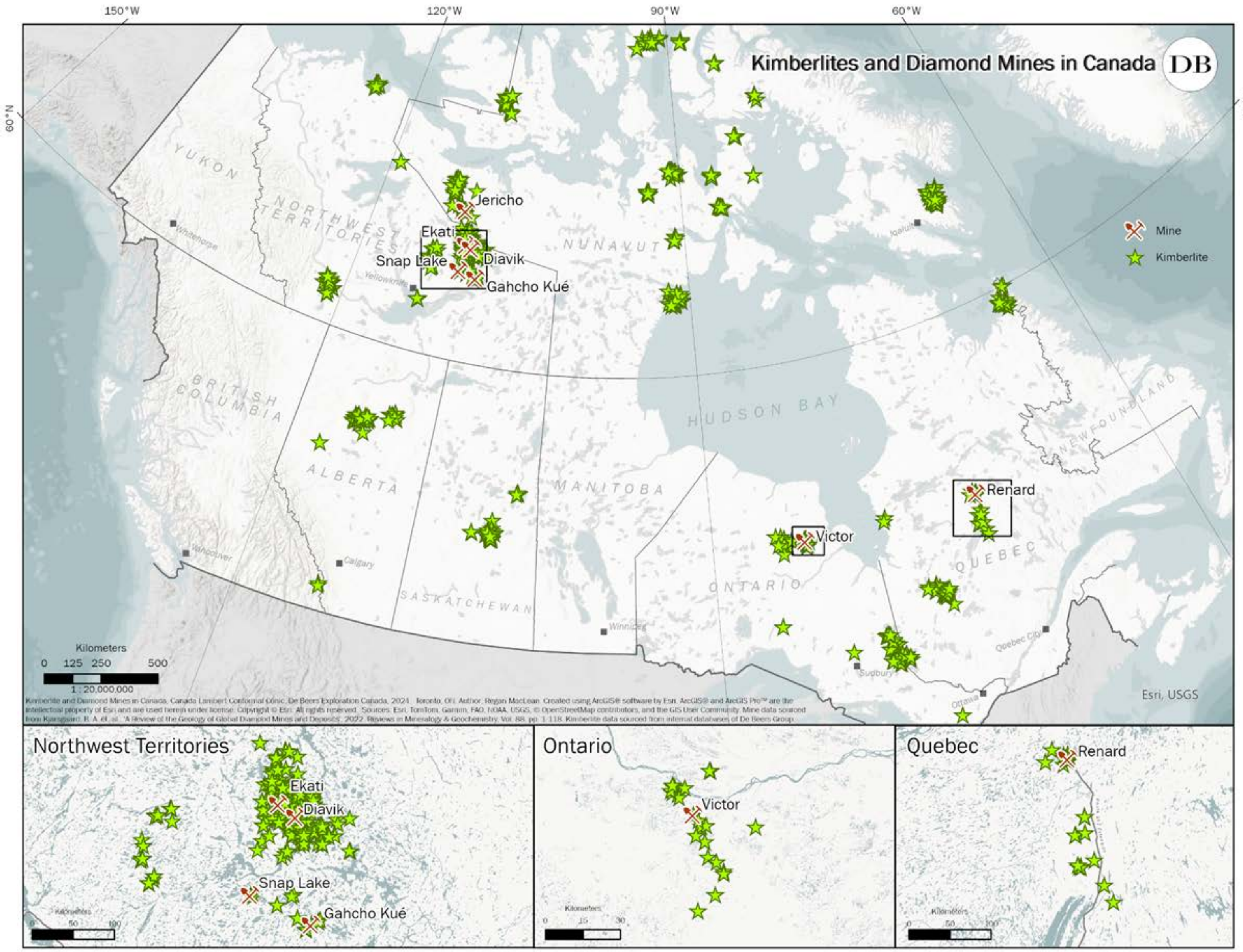

Figure 1: Map showing the location of known kimberlite occurrences across Canada, courtesy of De Beers Group.

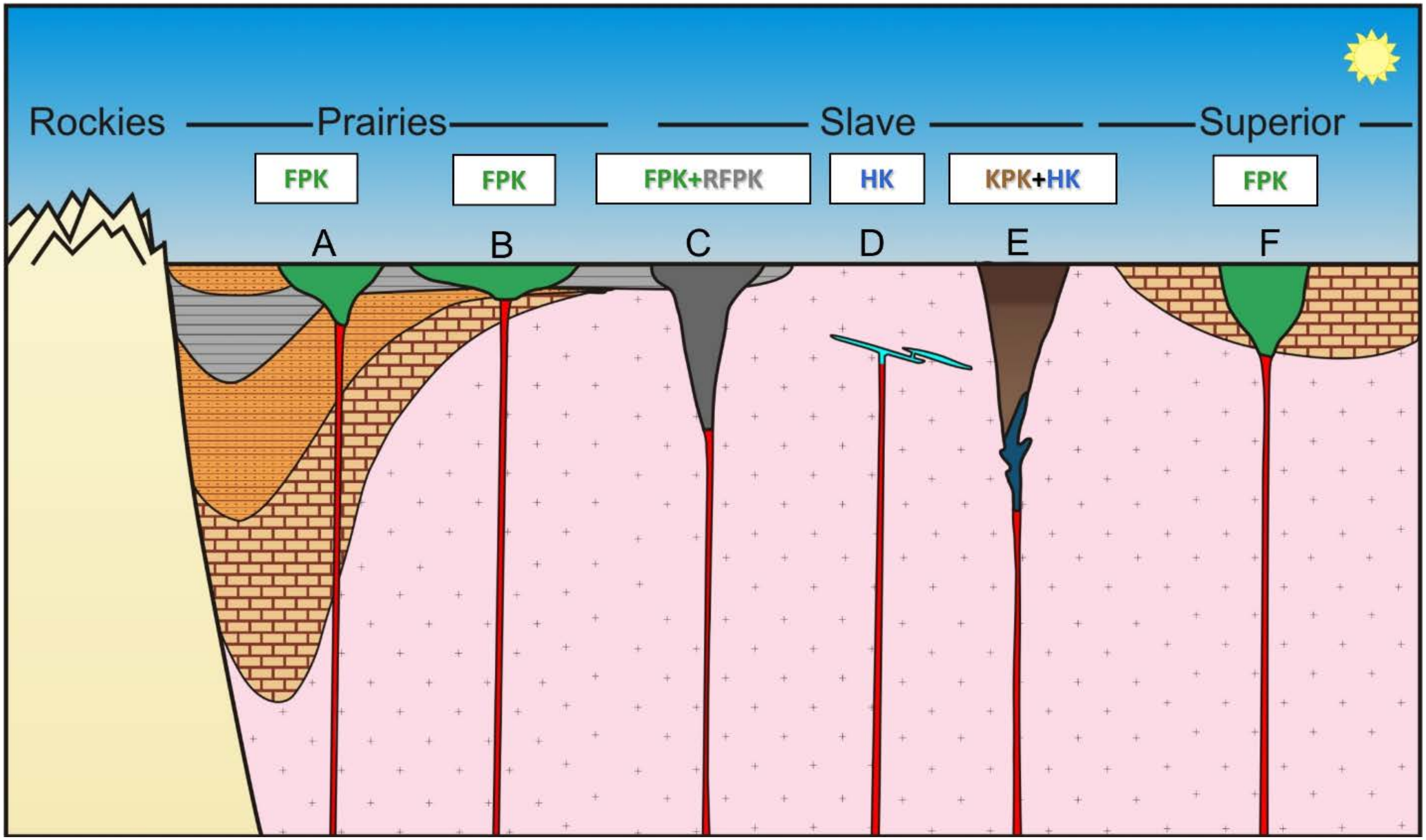

Figure 2: A schematic section across Canada summarising kimberlite pipe shapes, pipe infills and geological setting reconstructed to the time of emplacement based on approximately two thousand 1989-1999 drillcores (after Field and Scott Smith 1999 and Scott Smith 2006. Image credit: Scott-Smith Petrology Inc**.). Country rocks:** pink - basement, light brown - lithified Paleozoic carbonates, orange - partly consolidated Cretaceous siltstone, and pale grey - poorly consolidated Cretaceous shale. **Kimberlite Pipe Infill Types:** FPK - Fort à la Corne-type Pyroclastic Kimberlite, RFPK - Resedimented FPK, KPK - Kimberlite-type Pyroclastic Kimberlite and HK – Hypabyssal Kimberlite (after Scott Smith et al. 2013, 2018). **Localities: A** - Buffalo Head Hills, ~80-88 Ma., discovered in 1997; **B** - Fort à la Corne ~100 Ma., discovered in 1989; **C** - Lac de Gras, ~55 Ma., discovered in 1991; **D** - Snap Lake, ~530 Ma., discovered in 1997; **E** - Gahcho Kué, ~540 Ma., discovered in 1995; and **F** - Victor, ~170 Ma., discovered in 1988.

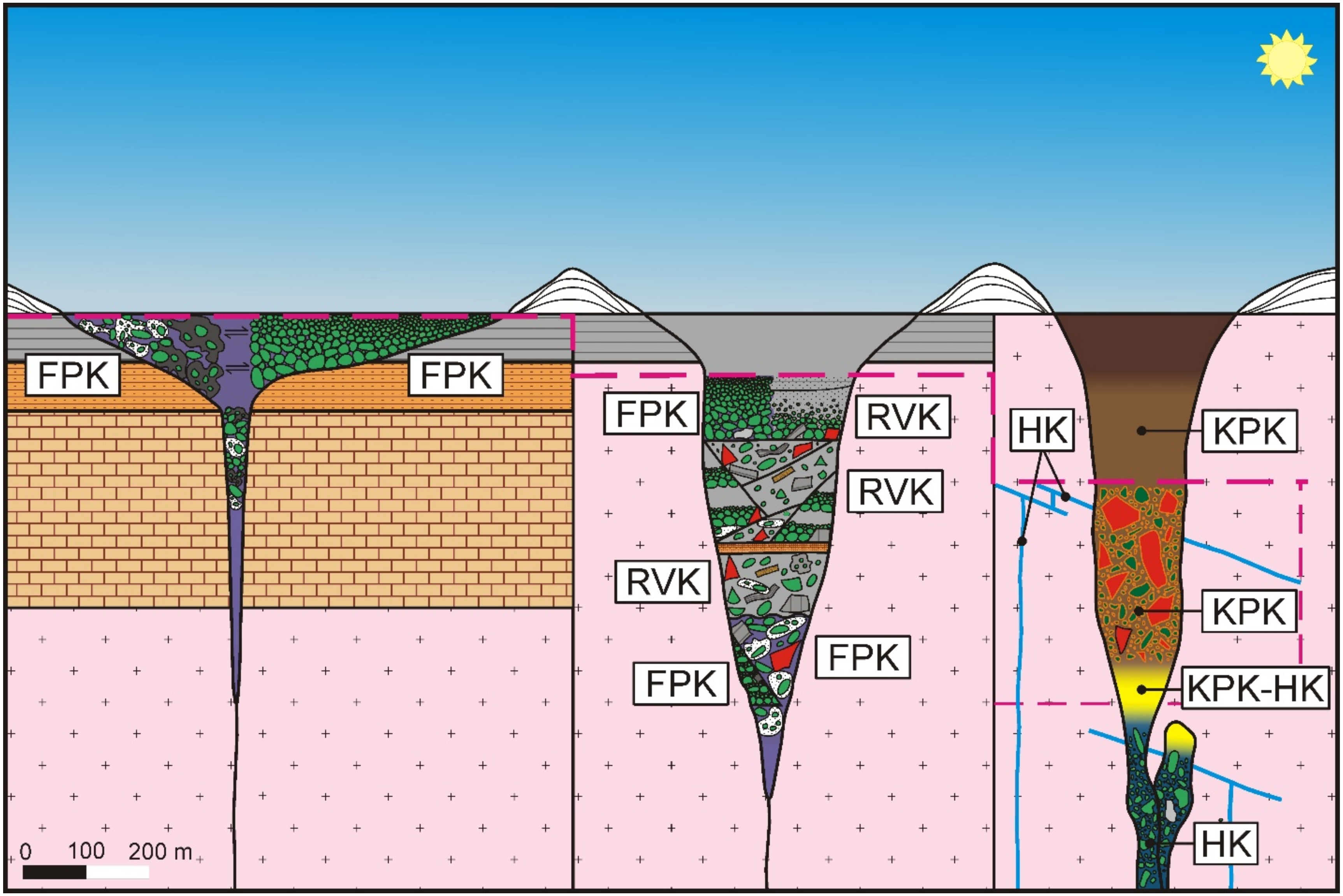

Figure 3: Schematic representation of the detailed geology of the three main types of kimberlite pipes in Figure 2 reconstructed to the time of emplacement (after Scott Smith 2008; Image credit: Scott-Smith Petrology Inc.). **Country rocks:** as Figure 2. **Kimberlite Pipe Infill Types**: as Figure 2; RVK = RFPK. Localities from Figure 2: Left hand pipe – B, centre pipe – C and right hand pipe – D and E in Figure 2. Pink dashed line = present surface.

References

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FT04 - Northwest Territories Kimberlite Drill Core Collection

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Core viewing at the Northwest Territories Geological Survey Geological Materials Storage Facility

On this field trip, core from a selection of NWT, Nunavut, and Quebec kimberlites will be available for viewing at the Government of the NWT Geological Materials Storage Facility in Yellowknife, NWT. The kimberlite available for viewing are shown below in **Figure 1** and **Table 1**. Note that sampling of drill core is not permitted, and drill core is to stay in the core boxes! If you wish to obtain kimberlite samples from the collection for research purposes, please read the client use section below and discuss it with one of the trip leaders.

Washrooms, warm up area and light refreshments are available.

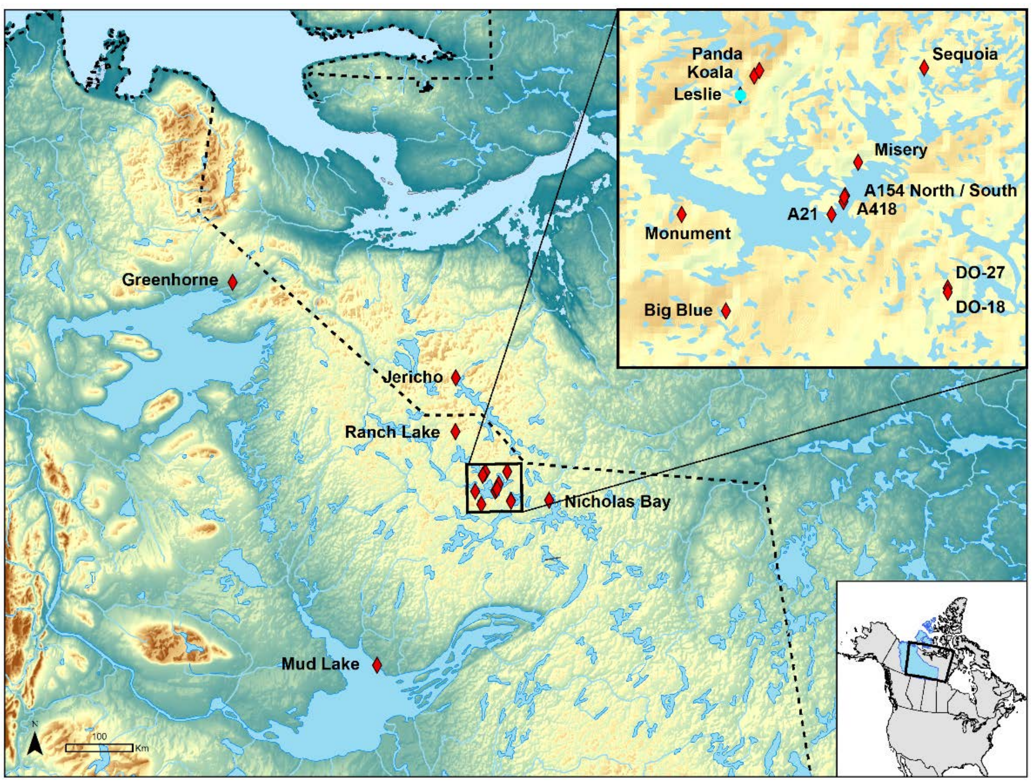

Figure 1: Location of drill core for the FT04 field trip

Safety First

The core warehouse has normal hazards which may be expected in a warehouse environment, this includes:

- Exposure to dust

- There is no climate control in the warehouse, participants will be exposed to ambient environmental conditions.
- Hazards from warehouse racking including some sharp edges on stored pallets and core boxes at floor and shoulder height.

Some additional hazards also exist because of the core laid out for inspection:

- Warehouse aisles and floors are being used for core display. This poses a tripping hazard.
- Access for viewing in aisles will be tighter than ideal, and it may be difficult to move quickly from one area to another. Patience is appreciated.

Mitigations to these hazards include:

- Long sleeved shirts, heavy fabric protective pants (such as blue jeans),
- Sturdy, stable footwear with closed toes and preferably ankle protection. Steel toed boots may be useful but are not required.
- Use of gloves and eye protection where appropriate.
- Careful deliberate movements will avoid tripping and scraping hazards.

Other considerations

Water bottles will be available for wetting the core, but please consider what you are wetting down. Many phases of volcaniclastic kimberlite do not stand up well to soaking. Please consider what you are wetting down, and be respectful. For the purposes of this field trip, core should remain in trays.

What is being displayed

The kimberlite drill core available for viewing is shown in **Figure 1** and listed in **Table 2**.

Table 1: Project name, drill hole number and general location of the kimberlites on display

Project	**Kimberlite**	**Hole**	**Field**
Diavik	A154N	A154-U360	Lac de Gras
Diavik	A154S	A154-U154	Lac de Gras
Diavik	A21	A21-30	Lac de Gras
Diavki	A418	A418-U259	Lac de Gras
Ekati	Leslie	LDC-01	Lac de Gras
Ekati	Misery	MGT-03	Lac de Gras
Ekati	Koala	KDC-6	Lac de Gras
Ekati	Panda	PUC1-5	Lac de Gras
Ranch Lake	Ranch Lake	ICE-96-002	North Slave /Nunavut
Jericho	Jericho	JGG-007	North Slave /Nunavut
Greenhorne	Dharma	DD08-G14-004	Bear Province
Nicholas Bay	Aylmer Lake	AD2-1-2	Aylmer Lake
Lac De Gras	Big Blue	BB 18-013c	Lac de Gras
Lac De Gras	Monument	DD 39-05	Lac de Gras
DO27/18	DO27	DO 27-17	Lac de Gras
DO27/18	DO18	DO 18-13	Lac de Gras

Diagras	Sequoia	DG2022-01	Lac de Gras
Renard	Renard 2	R2-200-253	Quebec

Photographs of the core, drill logs and other information as available are included in the digital appendix to this field guide at.

https://drive.google.com/drive/folders/1x9z-80V7mHsPWCRScZ_tk_htTEjfocow

Drill Core Layout

The drill core layout is summarized below in Figure 2.

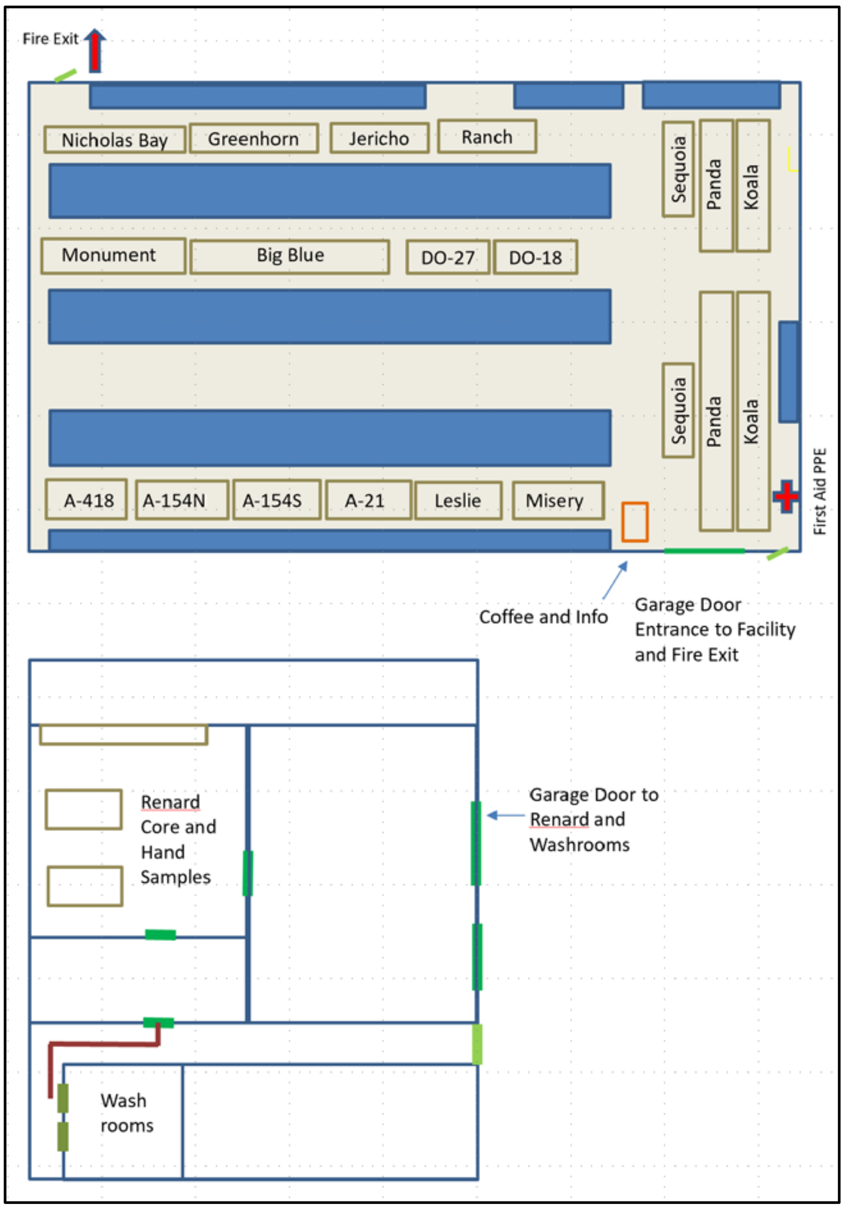

Figure 2: Drill core layout

Notes on the Facilities and the Collection

The GNWT Geological Materials Storage Facility opened in Yellowknife, Northwest Territories, Canada September 2017. The facility consists of an unheated storage area for the geological materials, as well as a heated viewing area. The materials in this collection are primarily from mineral exploration activities in the NWT and government geoscience programs. Petroleum core and cuttings for the NWT are handled by an agreement with the Geological Survey of Canada and are stored in the GSC core facility in Calgary, Alberta Canada.

Our collection includes portions of well over 1000 diamond drill holes donated by the mineral exploration industry and several thousand rock and surficial materials samples primarily Government Research and Mapping projects. We also curate surficial material (till samples, lake sediments), as well as thin sections, rejects and powders prepared on materials from past research.

With the past thirty years of diamond exploration in the NWT many kimberlites have been drilled and discovered. The core facility has been fortunate that many kimberlite drill holes have been donated to the core facility. As the facility makes publicly available a uniquely large collection of kimberlite samples, we also curate donations of kimberlite from outside of the Northwest Territories.

The heated viewing facility boasts space and racks to lay out considerable amounts of drill core. The facility is equipped for core logging, photography, microscopy and photomicroscopy.

Client Use

Supervised client access to the collection is by appointment, as much lead time as possible is requested in order to arrange supervision and assistance while examining samples. Examination, logging, photographing and non-destructive testing of the collection is supervised but otherwise unregulated. Results of such work are welcome to be added to the collection, but are not required. Typically, there will be no charge for such access, however if it is necessary to hire a contractor to assist in supervision, then these fees may be passed on to the client.

As the collection is owned by the GNWT for the benefit of the public, sampling and destructive testing of sample materials requires a written agreement with the NTGS. Destructive testing agreements will be predicated on obtaining the most data possible from the sample aliquot being destroyed, destruction of the smallest amount of sample possible for the testing, and maintaining sufficient representative sample of the material in the collection (see guidelines below). All data generated from destructive testing will be forthright provided to the NTGS and will become publicly available without restriction. Reports detailing the client's interpretations of the test results are welcomed by the NTGS but are not mandatory. Publications arising from use of the collection will acknowledge the NTGS and this facility, a copy of such publication should be sent to the NTGS when published and will be added to the collection database. A minority of materials in the collection have certain other conditions for use attached to them by their donors, the conditions will be disclosed to researchers when reviewing the destructive testing application.

Guidelines for Destructive Sampling Proposals

The Northwest Territories Geological Survey (NTGS) archives geological materials for inspection to facilitate mineral exploration and scientific investigations. The materials are available for inspection and study. Destructive testing of the materials may be done through mutual agreement between the NTGS and the interested party. In any agreement for destructive testing the NTGS will require;

- A sufficient quantity of archive material remains available for inspection in the collection
- All data from the destructive testing becomes a matter of public record, and available for inspection with the collection upon receipt by the researcher
- The destructive test will yield the maximum amount of data from the sample. This may mean selecting the most comprehensive geochemical package, or inclusion of other analytical tests which may be beyond the scope of the research proposed.
- All powders, thin sections, prepared samples, rejects etc. will be returned to the NTGS archives at the completion of the testing.
- Publications arising from the testing will acknowledge the NTGS Geological Materials Storage Facility.

After an initial review to ensure the request is compatible with the above criteria, a group of NTGS geologist will meet to discuss the proposal. The group may:

- Accept the proposal,
- Accept the proposal with additional conditions or tests,
- Reject the proposal,
- Ask for more information regarding the proposal.

The agreement may be negotiated and amended by the written consent of both parties.

Do you have Kimberlite Materials you may wish to donate?

Donations to the collection are welcomed on a case by case basis. The NTGS is interested in curating well-characterised samples from mineral occurrences not represented in the collection. Drill intersections best exemplifying the mineralisation, structure and stratigraphy of a showing are most desired. Core donations complete with data such as drill logs, sections, geochemistry, and photos are preferred.

Tindi, the 12 IKC Mascot!

A Twin Otter, an essential part of
30 Years of Diamonds in Canada
and the Canadian North