

# THE DIAVIK DIAMOND MINE, LAC DE GRAS, NORTHWEST TERRITORIES, CANADA

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## INTRODUCTION

The Diavik Diamond Mine is an unincorporated joint venture between Diavik Diamond Mines Inc. and Aber Diamond Mines Ltd., both headquartered in Yellowknife, Northwest Territories. Diavik Diamond Mines Inc., a wholly owned subsidiary of Rio Tinto plc of London, England, is the project operator and retains a 60 % interest in the project. Aber Diamond Mines Ltd., a wholly owned subsidiary of Aber Diamond Corporation of Toronto, holds the remaining 40 % interest in the project. The partners retain the right to receive and market their share of all diamonds produced at the mine.

The Diavik Mine is located 300 km northeast of Yellowknife, NWT. This remote site, located within the sub-Arctic “barren lands”, is most easily accessed by aircraft, and is linked in winter months by a temporary “ice road” to Yellowknife. The mine infrastructure is contained on the 20 sq. km. East Island, which is located in the eastern end of Lac de Gras (Fig. 1). The four project kimberlites, located beneath shallow waters immediately east of the island, will be mined over a twenty-year period. Access to the A154 South and A154 North kimberlites was enabled through the construction of a temporary dike (Fig. 2). Similar dikes are planned for the A418 and A21 kimberlites. The Diavik project includes 263,000 ha under mineral claims and mining leases. Sixty-three kimberlite occurrences, approximately 50% of them diamond bearing, have been located on the property. Staged exploration programs are on-going throughout the property.

The current Diavik resource includes the A154 South, A154 North, A418, and A21 kimberlites. Both the A154 South and A154 North kimberlites will initially be mined by open pit methods from the A154 open pit. Open pits, beginning in 2009 and 2013 respectively, will develop the A418 and A21 kimberlites. Underground mining is also planned for the A154 South and A418 kimberlites. Infrastructure development and mine construction began in 2000 following regulatory approvals. Initial recovery of the A154 South kimberlite began in November 2002, and by January 2003 had reached sufficient production level to allow the first diamonds to be delivered to the project partners, several months ahead of schedule. Ramp up to full production is continuing. The project is within the C\$1.3 billion capital budget.

## PROJECT HISTORY

Aber Resources Ltd. and partners began claim staking in the Lac de Gras area in mid November 1991, during the initial stages of a staking rush that eventually encompassed

much of the Slave Province. The four mineral claims covering the Diavik project kimberlites were staked in late November 1991. By early 1992, the group had acquired some 325,000 ha in mineral claims. In 1992, a joint venture agreement was formed between Aber Resources Ltd. and partners, and Kennecott Canada. During the spring of 1992, a property-wide helicopter-borne magnetic and electromagnetic survey was completed. In mid- to late-1992, glacial till samples collected down ice from the more prospective targets were analyzed for kimberlite indicator minerals. The initial 1992 - 1993 diamond drill program focused upon the testing of discrete, strong total field magnetic lows. Early kimberlite discoveries were tempered by low microdiamond counts. In early 1994, an evolving exploration strategy focused upon a series of weak geophysical anomalies, enhanced through positive glacial till sampling results.



Figure 1. Location of the Diavik Diamond Mine on East Island at the east end of Lac de Gras, with the location of the Ekati mine also shown.

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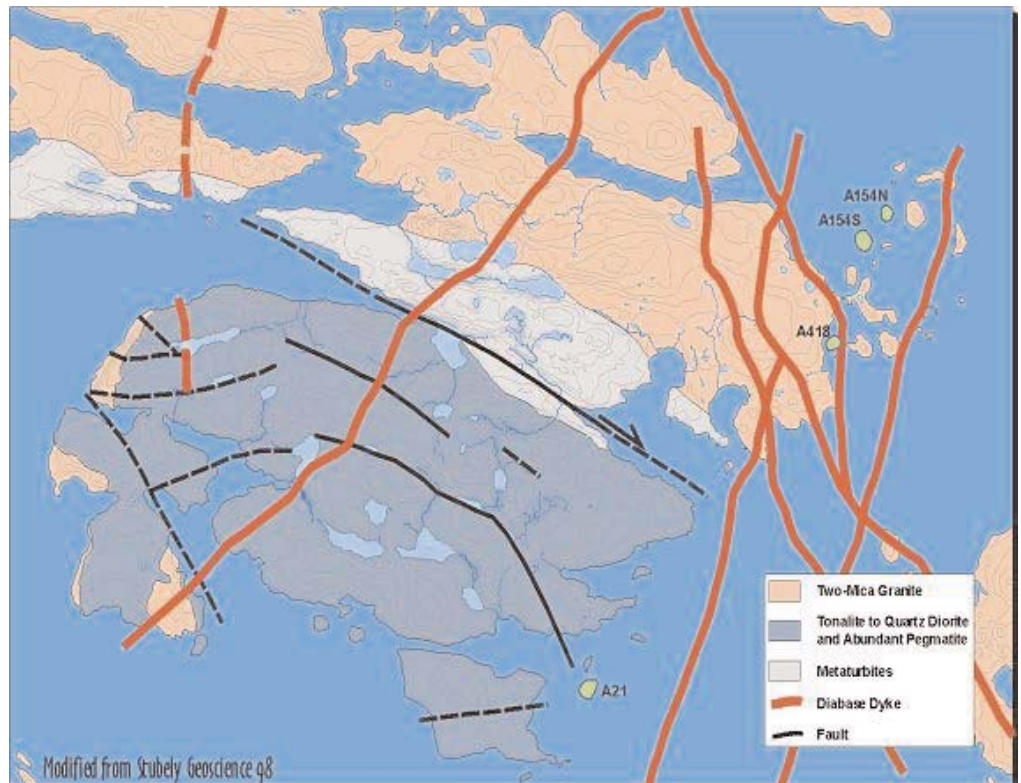
2003: The Diavik Diamond Mine, Lac de Gras, Northwest Territories, Canada; in VIIIth International Kimberlite Conference, Slave Province and Northern Alberta Field Trip Guidebook, B. A. Kjarsgaard (ed.); p. 61-65.



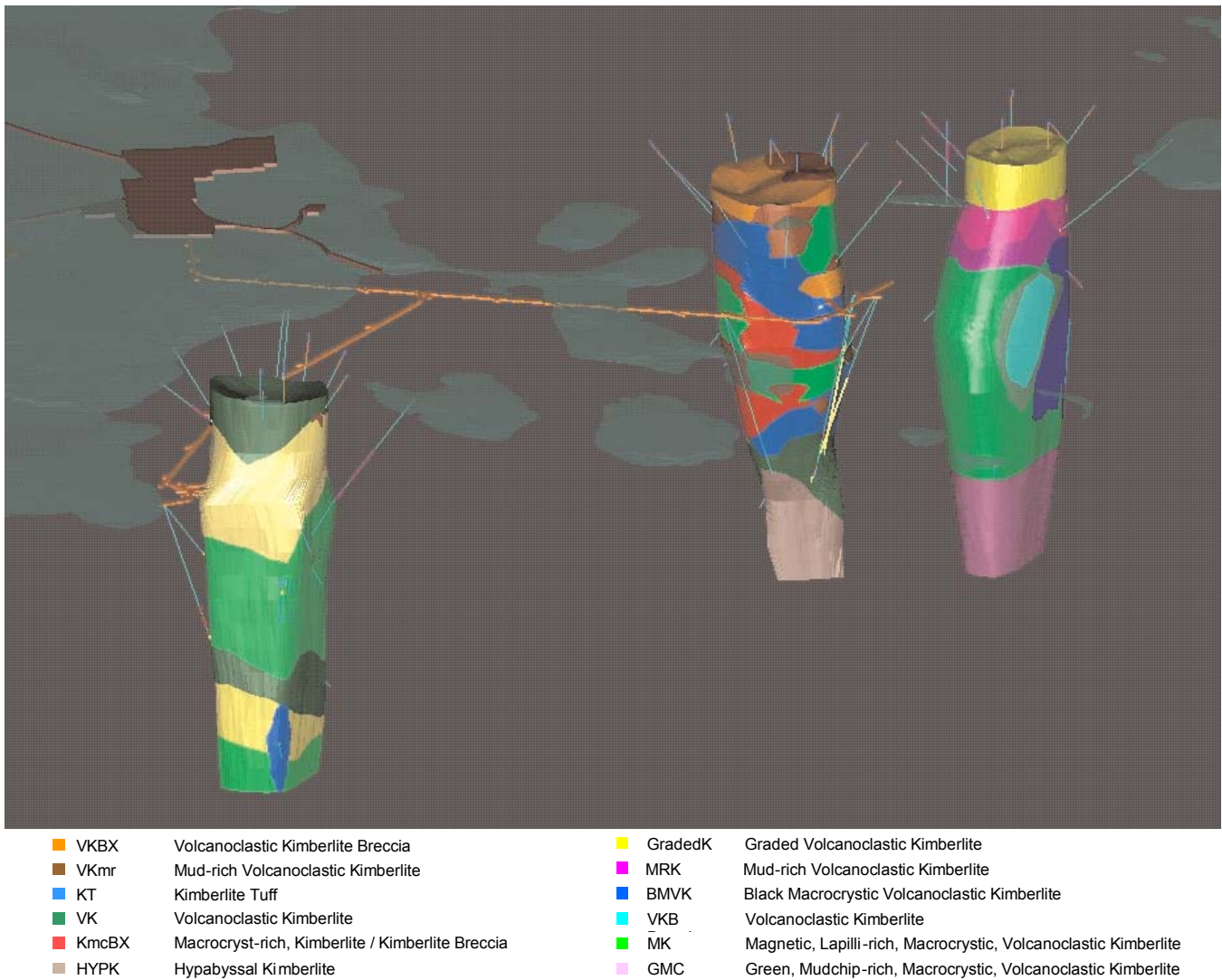


Figure 2. Dewatered area around the A154 North and A154 South kimberlites within the dyke area, September 2002.

Figure 3. Simplified bedrock geology of East Island (from Stubley, 1998).







**Figure 4.** A418, A154 South, and A154 North (left to right) kimberlite solids models with detailed geology.

These anomalies were situated adjacent to East Island in Lac de Gras.

The A21 kimberlite was drill tested from the ice of Lac de Gras in April 1994. The discovery of A154 South followed in May 1994. The A154 North kimberlite was drill tested from a barge mounted drill rig in late 1994 and the A418 kimberlite was intersected in the spring of 1995.

Kimberlite delineation and grade evaluation drilling programs began in 1995. The geometry of the four kimberlites was established through a series of inclined diamond drill holes, with grade determinations based on a series of large diameter (~15.2 cm) vertical drill holes, beginning with A154 South and A154 North in 1995, followed by A418 in 1996 and A21 in 1997. A bulk sampling program of A154 South was completed in April 1996. A total of 2,585 dry tonnes of kimberlite, collected from underground workings some 145 m below lake level, returned 12,763 carats. Further underground development in 1996 recovered 3,350 dry tones of kimberlite from the A418 kimberlite. This bulk sample yielded 8,323 carats.

## GEOLOGICAL SETTING

The Precambrian geological setting of the Diavik project pipes is characteristic of the central Slave Province. Three main Archean rock units, greywacke–mudstone metaturbidites, tonalite–quartz diorite, and two–mica granite are observed on East Island (Fig. 3). The greywacke–mudstone turbidites are preserved in a northwest–southeast trending, steeply dipping, corridor extending through central East Island. The ca. 2610 - 2600 Ma tonalite–quartz diorite, prevalent on the southern portion of East Island and host to the A21 kimberlite, intruded the metaturbidite terrane as a steep-sided stock. The ca. 2590 – 2580 Ma two mica granite suite, underlying much of the northern part of East Island and hosting the A154 South, A154 North, and A418 kimberlites, forms a dyke and sheet complex. This complex has split and separated the metaturbidites, both horizontally and vertically, into variably sized blocks (Stubley, 1998). Three Proterozoic diabase dyke sets cut the Archean stratigraphy, including the northeast trending Malley (or Contwoyto, ca. 2.23 Ga), the north-northeast trending Lac de Gras (ca. 2.02 Ga), and the northwest trending Mackenzie dykes (1.27 Ga).



**Figure 5.** Volcaniclastic kimberlite overlying muddy serpentinized kimberlite (lighter grey).

The glacially deposited material in the project area is dominated by till deposits associated with the retreat of the Laurentide ice sheet following a Late Wisconsin phase of glaciation that climaxed approximately 20,000 BP (Graham et al., 1999). Glacial retreat is thought to have occurred between 14,000 and 8,400 BP (Dyke and Prest, 1987). Fossil evidence suggests the area was deglaciated approximately 8,500 BP (Dredge et al., 1995). Glacial cover, found below a thin (1.0 - 3.0 m) lake bottom sediment layer exposed through the de-watering of the A154 pit, has been identified as dominantly glacio-fluvial deglaciation deposits. Reworked portions have formed small Holocene littoral sediments that include thin discontinuous organic mats. Recent work by the Geological Survey of Canada determined a radiocarbon date on birch twigs collected from one mat dated to 7720 +/- 100 years BP (GSC-6658) (D. Kerr, GSC, pers. comm., 2002). In the A154 pit, the glacial deposits are up to 30 m in thickness. A thin (0.5 - 1.0 m), discontinuous, layer of mixed boulders and clay-rich till has been observed directly overlying the A154 South kimberlite. Kimberlite fragments are present within this unit.

### KIMBERLITE GEOLOGY

The Eocene aged Diavik kimberlites occur as small (<2 ha), steep sided, semi-circular bodies in plan view. These kimberlites are roughly aligned along an approximate 030° trend. A narrow, kimberlite infilled fault, roughly paralleling this trend and extending to the north-northeast from the A154 South kimberlite, was recently exposed during mining operations. A similar occurrence was recently excavated, along trend, on the north edge of the A154 North kimberlite.

The Diavik kimberlites contain interpreted crater and hypabyssal facies rocks. Pyroclastic and resedimented volcaniclastic rocks are the dominant lithologies (Fig. 4). The upper surface of the A154 South kimberlite, based on recent excavations, appears to be characterized by bedded sequences of tuffs, tuff breccias, and resedimented volcaniclastic rocks (Fig. 5). Exposed bed thicknesses are variable from 3 to 4 m. Bedding, while locally chaotic, generally dips at shallow angles toward the centre of the kimberlite.



**Figure 6.** Contact of the A154 South kimberlite (left) and wallrock (right).

Kimberlite mud and Cretaceous mud clasts are common. Hypabyssal kimberlite typically occurs along the margin of the kimberlites and is observed along the east margin of the A154 South pipe. This more competent unit, ranging from 1 to 3 m in thickness, occurs as a ridge and appears to have a steep dip towards the centre of the kimberlite.

Dilution by country rock xenoliths appears to be minimal, with the exception of Cretaceous mudstones that dominate some kimberlite units (from particulate mixed mud to large xenoliths) particularly in the A21 and A418 kimberlites. The kimberlite contact with the host rocks is often sharp, with visible alteration restricted to a 1.0 - 1.25 m contact zone (Fig. 6). Flat-lying metasediments in contact with the eastern margin of the kimberlite have been uplifted.

### THE DIAVIK RESOURCE

Resource estimates for the Diavik kimberlites are based on information gained through small diameter delineation and geotechnical drilling programs. Grade and valuation data for the A154 South and A418 kimberlites are based on large diameter drilling programs combined with underground bulk sample results. Large samples have not been taken from the A154 North and A21 kimberlites; as such their valuations are based on limited diamond information.

**Table 1.** The Diavik Resource

Kimberlite	Global Resource (Mt)*	Grade (cpt)	Carats (Mct)
A154 South	11.7	4.8	55.2
A154 North	2.9	3.1	9.1
A418	8.6	3.4	30.7
A21	3.9	3	11.7
Total	27.1	3.9	106.7

\* Resource to mean sea level (approximately 415 m below lake level)

\*\* Based on a valuation exercise completed in June 2000

Diluted mineable reserves are estimated at 27.1 million tonnes containing 106.7 million carats, at an average reserve grade of 3.9 carats per tonne (Table 1). The average diamond value, based on the 2000 valuation, is US\$ 62.00 per carat.

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