KIMBERLITES IN THE SLAVE STRUCTURAL PROVINCE, NORTHWEST TERRITORIES, CANADA: A PRELIMINARY REVIEW

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The Slave Structural Province of the Northwest Territories, northern Canada is an Archean segment of the North American Craton that covers 213 000 km^2. It is composed of granites, gneisses and supracrustal rocks. Sialic basement remnants are well documented in the Slave; the oldest rocks in the world, the Acasta gneisses, which have been dated at 4.02 Ga, are found in the western part of the province. Metasedimentary and lesser metavolcanic rocks of the Yellowknife Supergroup, deposited mainly between 2.71 and 2.61 Ga, dominate the supracrustal sequences. Syn- to post-volcanic granitoid plutons cover approximately 65% of the Slave (Padgham and Fyson, 1992). Four swarms of Proterozoic diabase dykes, ranging in age from 1.27 to 2.23 Ga, cut the older units (LeCheminant and van Breeman, 1994). The Slave Province is a classical setting for diamondiferous kimberlites; a stable Archean craton with, as suggested by seismic tomography, a cool mantle root (Anderson et. al., 1992).

Kimberlites were first found in the Slave Province in 1991 and since then over 100 pipes have been found. Few of the kimberlites in the Slave Province outcrop; most have been discovered using a combination of heavy mineral sampling, geophysical techniques and drilling. Many of the pipes have well developed indicator mineral trails within the glacial tills that cover much of the area and are characterized by magnetic anomalies (either highs or lows) and resistivity lows.

The majority of Slave pipes cluster in a northwest-trending zone, roughly parallel to the Bathurst Fault, a Proterozoic structure related to the docking of the Slave with the Rae (Churchill) Province (Hoffman, 1989). This zone, which is approximately 135 kilometres long, is centred north of Lac de Gras, in the centre of the Slave Province (Figure 1). Many of the pipes in this zone appear to be aligned along conjugate, northeast-trending structures. Crater facies, diatreme facies and massive, hypabbysal facies kimberlites are all present and the pipes range from less than 2 to slightly over 12 hectares in area. Their xenocryst suite is characterized by abundant macrocrysts of olivine (up to 1 cm in size), chrome diopside (>2 cm), garnets (to 0.5 cm), chromites and ilmenites. Serpentine, calcite, monticellite, perovskite and magnetite occur as groundmass minerals. Peridotite xenoliths occur is some pipes and granitic fragments are common. Volcaniclastic diatreme breccias and crater facies pyroclastics also contain wood fragments and siltstone and mudstone lithoclasts from which dinoflagellates, pollen, spores and teleost fish remains have been recovered. Palynological work on mudstone fragments from thirteen of the pipes north of Lac de Gras gave fossils that range in age from Early Cretaceous (Albian, 97 Ma) to Tertiary (Paleocene, 56 Ma) and are the first evidence of a preexisting Cretaceous and Tertiary cover in the Slave Province (Nassichuk and McIntyre, 1995). Rubidium-strontium systematics were used to obtain an isochron age of 52 +/- 1.2 Ma on two of the pipes in the central part of the Lac de Gras area, which closely supports the paleontological evidence. A U-Pb isotopic age of 86 +/- 2 Ma was obtained from perovskite in one pipe near the southern end of the cluster, southeast of Lac de Gras (C. Jennings, pers. comm., 1994). This indicates that within the Lac de Gras "cluster", kimberlites were emplaced in both the Cretaceous and Tertiary.

Bulk samples (>1000 tonnes) have been obtained from four pipes and mini-bulk samples (2 to 500 tonnes) from nine others (Table 1). The Panda pipe, north of Lac de Gras (Figure 1) has returned the best results to date; nearly 2800 carats of diamonds were recovered from approximately 3000 tonnes of kimberlite for a grade of 93 carats/100 tonnes and an average value of US$ 132 per carat. Two pipes from which smaller samples were obtained yielded grades in excess of 300 carats/100 tonnes. Exploration and evaluation is ongoing and, provided continued favourable results and timely environmental approvals, it is expected that at least two pipes will be in production within the next three or four years.

TABLE 1 - BULK SAMPLING RESULT SUMMARY, LAC DE GRAS KIMBERLITES

Pipe	Weight (tonnes)	Carats	Carats/100tonne	US$/Carat	$per tonne	Company
Fox	7766	2060	27	$126	$34	BHP
Koala	1193	893	75	$110	$82	BHP
Panda	2987	2778	93	$132	$123	BHP
DO-27	4261	1095	26	$22	$6	Kennecott
A-154	13	61	480	na	na	Aber
Falcon	426	120	28	$17	$5	BHP
Leslie	152	65	43	$89	$38	BHP
Misery	132	437	330	$43	$142	BHP
Misery S	36	27	75	$37	$28	BHP
Pipe 2	21	18	85	na	na	BHP
Point Lake	161	101	63	na	na	BHP
Ranch Lake	28	5	19	na	na	Lytton
Torrie	25	<1	3	na	na	Tanqueray

A second cluster of pipes apparently defining an east-northeasterly-trending zone in the Lac de Gras/Aylmer Lake area, overlaps the southern end of the Lac de Gras cluster. This zone is approximately 100 km long and is roughly parallel to the MacDonald Fault, another Proterozoic structure related to the docking of the Slave Province (Hoffman, 1989). Pipes in this region contain diatreme and hypabbysal facies material; they tend to contain less abundant olivine macrocrysts, fewer indicator minerals and more country rock fragments than those in the Lac de Gras area. Wood fragments and mudstone chips have not been reported. No information on the age of these pipes has been released. Further study is required to assess the significance of parallelism between kimberlite trends and regional Proterozoic structures. Kimberlites have also been discovered in the Slave Province, outside the Lac de Gras/Aylmer Lake area (Figure 1), some as far away as Great Slave Lake, approximately 330 km to the south-southwest. Many of the pipes outside the Lac de Gras area contain some diamonds and one, the Kennedy Lake kimberlite (Figure 1), has returned good initial results, yielding 176 macrodiamonds (>0.5mm) and 810 microdiamonds from a 63 kilogram sample. As exploration continues, it is likely that more kimberlites will be found and a better understanding of their ages, petrology and diamond potential will be gained.

References

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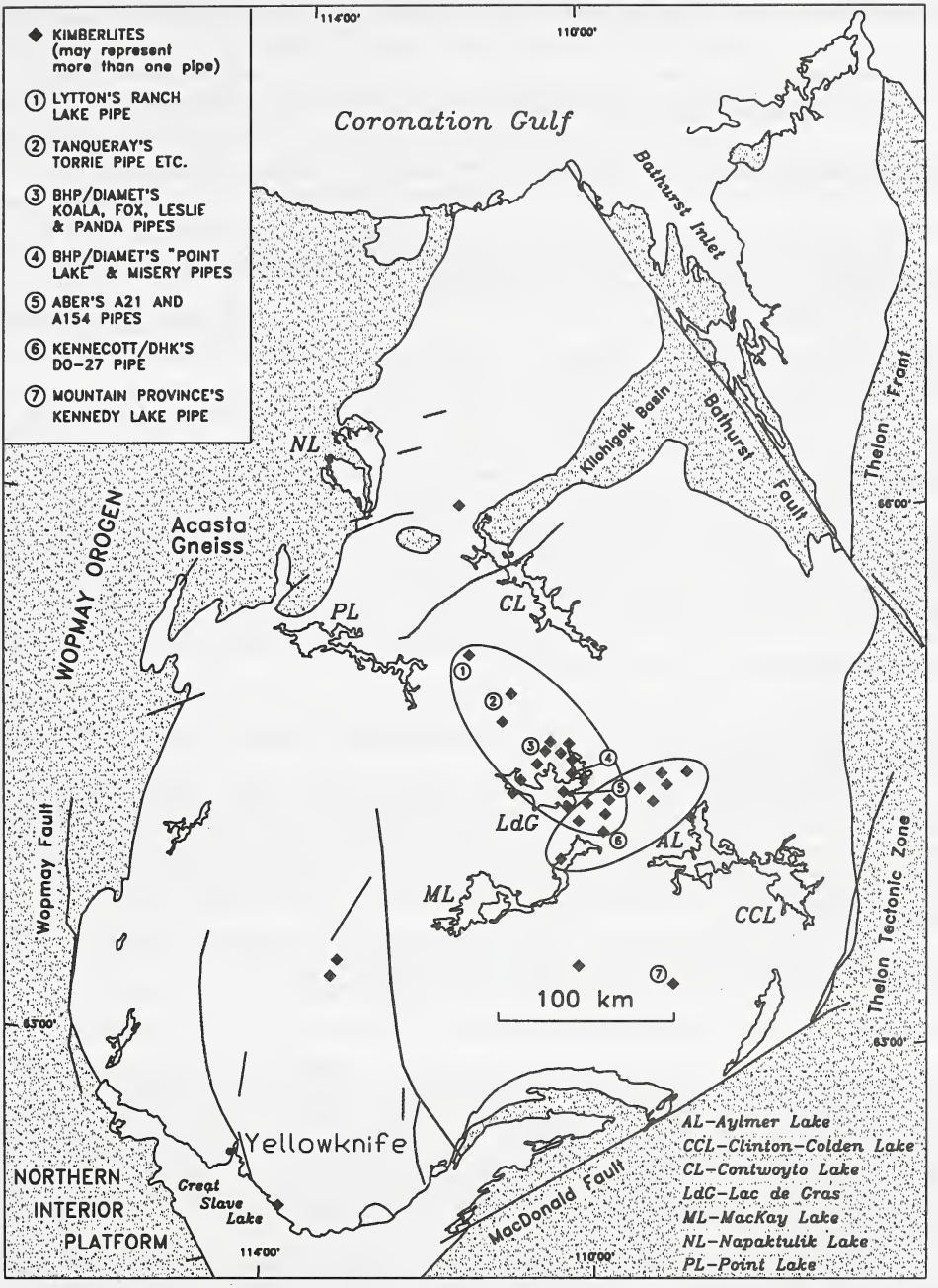

Figure 1. Location of kimberlites in the Slave Structural Province. Hatch pattern indicates post Archean rocks.