Morphology and Carbon Isotope Composition of Microdiamonds from Dachine, French Guiana

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ABSTRACT

A selection of microdiamonds from the Dachine area, French Guiana, were examined for characteristics that might reveal the genesis of this unusual diamond occurrence. Morphology and surface features suggest that the Dachine diamonds are derived from mantle source rocks, and were subjected to resorption in a volatile-rich transporting magma similar to kimberlite or lamproite. The diamonds were subsequently weathered from their igneous host and carried only a short distance by eluvial and alluvial processes. In contrast to diamonds in kimberlite and lamproite, carbon isotopic signatures are dominantly ^{13}C-depleted, suggesting an eclogitic parent rock.

Keywords: French Guiana, diamonds, microdiamonds, carbon isotopes, morphology

1. INTRODUCTION

The Bureau de Recherches Géologiques et Minières (BRGM) first recovered diamonds in the Inini basin in 1975 in the course of a regional heavy mineral prospecting campaign. Subsequent follow-up in 1978 confirmed a diamond anomaly in the headwaters of the Grand Inini Creek. Detailed exploration of the IT 33 occurrence by the BRGM from 1979 to 1981 established small eluvial and alluvial deposits of uncertain economic potential due to the overall small stone size. An ultrabasic rock was identified as a possible source. Work by Guyanor Ressources in 1995 positively identified the source rock as a talc schist with a texture suggesting a volcanic tuff or breccia. Details of the geology are described in Bailey *et al.* (1998). A short due diligence campaign on the IT 33 diamond occurrence by Guyanor Ressources (a company held 70 % by Golden Star that operates entirely in French Guiana) in late 1994 confirmed the presence of abundant diamonds in the Dachine project area. In the course of the latter, 1250 diamonds from 1.6 to 0.25 mm in size were recovered from seven samples of eluvium and one of alluvium totaling 251 kg. The diamonds were recovered by sieving, acid treatment, and heavy liquid separation. A subset of 464 diamonds from both material types was subjected to a morphological and carbon isotope study to better characterise their source regions in the mantle, and to decipher subsequent processes (e.g., weathering, transport) that the diamonds may have experienced.

2. METHODS

Each diamond was individually examined under ~80x magnification on a binocular microscope to determine colour, size, inclusions and shape. A qualitative colour grouping was made, and does not correlate with the colour schemes used in the diamond grading profession. In many cases the colours are not body colours, but due to inclusion abundance. Sizes given in microns are rough estimates, intended to provide relative differences in size for the diamonds. The diamonds were covered with a 300 angstrom thick conductive coating of gold using a gold sputter coater, and placed in a Cambridge Stereoscan 120 scanning electron microscope (SEM) for individual descriptions of surface textures. SEM images for selected microdiamonds were obtained and are compiled with descriptions in Figs. 1-4. The terminology used for shape and surface textures is previously described in McCandless *et al.*, (1994; Table 1).

A total of 23 microdiamonds were selected for carbon isotope analysis. The diamonds were cleaned in aqua regia, followed by ethanol, and dried under a heat lamp. Each diamond was placed in a 6mm i.d. vicor glass tube with 1 gram of CuO. Prior to adding the diamond, the vicor tubes and CuO were degassed by heating at 850 °C for two hours. The diamonds were sealed in the tubes under vacuum, then placed in a muffle furnace at 900 °C for 12 hours to ensure complete conversion of C to CO_2. The CO_2 was measured on a Finnigan-MAT Delta-S gas source mass spectrometer with an instrumental precision of ±0.15 ‰ one sigma. All values are reported as $\delta^{13}C$ in per mil (‰) relative to PDB standard.

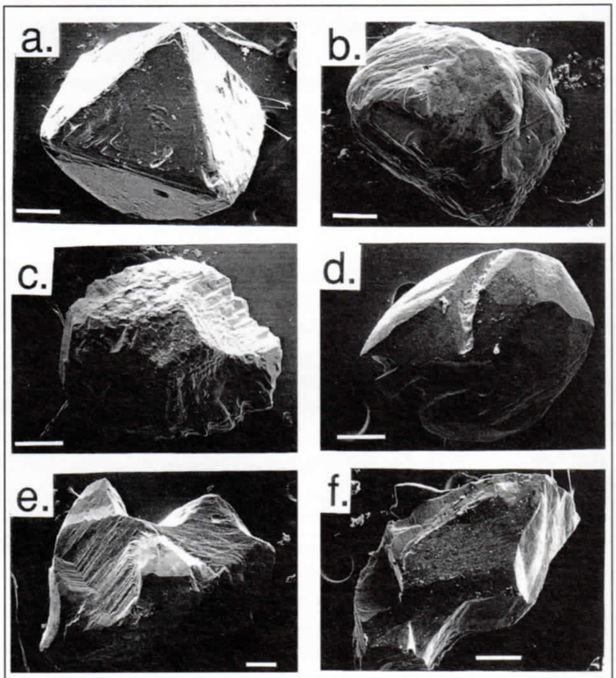

Figure 1. A selection of larger diamonds from Dachine. **(a)** 1-2-81. Octahedron, frosted surfaces, hexagonal and trigonal pits on upper right surface, serrate laminae **(b)** 1-3-45. Octahedron with uneven resorption, ribbing, to hillocks and low relief surfaces on upper left. **(c)** 1-3-5. Cube-octahedron with uneven resorption, ribbing, serrate laminae, crescentic steps on upper left. **(d)** 1-3-3. Tetrahexahedroid (thh) with low relief surfaces, hillocks, ruts, and a remnant octahedral surface on the right. **(e)** 1-2-82. Irregular fragment with low relief surfaces. **(f)** 1-2-62. Thh fragment with lamination lines, low relief surfaces. All scale bars 200 microns.

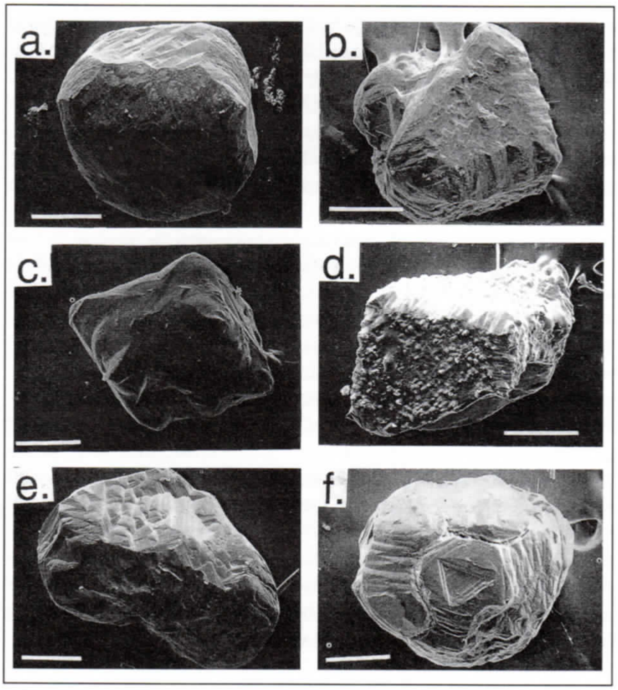

Figure 2. Cube and cube-octahedral forms. **(a)** 1-2-1. Cube with hillocks on the front surface and tetragonal pits on upper surfaces. **(b)** 2-2-138. Cube with tetragonal pits in the centre and hillocks along the edges. **(c)** 1-3-16. Cube with low relief surfaces. **(d)** 1-2-74. Cube fragment with diagonal break, tetragonal pits and knob-like asperities on the front surface. **(e)** 2-2-71. Cube-octahedron twin, tetragonal pits on the upper surface and hillocks on the right. **(f)** 2-2-59. Cube-octahedron, hillocks, low relief surfaces with a trigonal pit on a remnant octahedral surface on the right. All scale bars 200 microns.

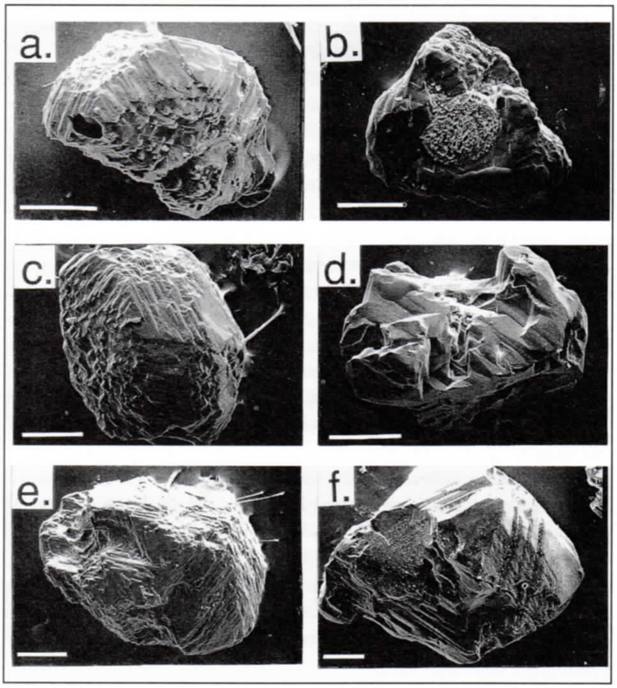

Figure 4. Diamonds with xenocrystic surface features. **(a)** 2-2-14. Octahedron with ribbing, serrate laminae, knob-like asperities. **(b)** 1-2-12. Irregular fragment with cubic surfaces features, ribbing, etched silicate intergrowth, knob-like asperities and tetragonal pits on lower centre. **(c)** 1-2-40. Cube-octahedron with ribbing, tetragonal pits, knob-like asperities on upper and right surfaces. **(d)** 2-2-70. Octahedral fragment with low relief surfaces, inclusion pits. **(e)** 1-2-63. Octahedral fragment with ribbing, serrate laminae, knob-like asperities on front and upper surfaces. **(f)** 1-2-108. Octahedron, cracked crystal with slightly resorbed edges. All scale bars 200 microns.

3. RESULTS

3.1 Morphology

3.1(a) Primary forms

With respect to whole crystals, the Dachine diamonds have a significant component of cube and cube-octahedral forms (33 %; Table 2). Octahedra and octahedral aggregates comprise 50 % of the unbroken crystal population, and tetrahexahedroida are 16 %. This is in contrast to microdiamonds from kimberlites and lamproites which are dominated by octahedra (>90 %), and cubes and tetrahexahedroida are rare (<6 %; McCandless, 1989; McCandless and Gurney, 1995). The percentage of fragments in the total population (73 %) is similar to microdiamonds from kimberlite and lamproite, although surface features differ significantly as discussed below. The most common size for the Dachine diamonds is 200-300 microns, with 7 % being greater than 500 microns (Table 2).

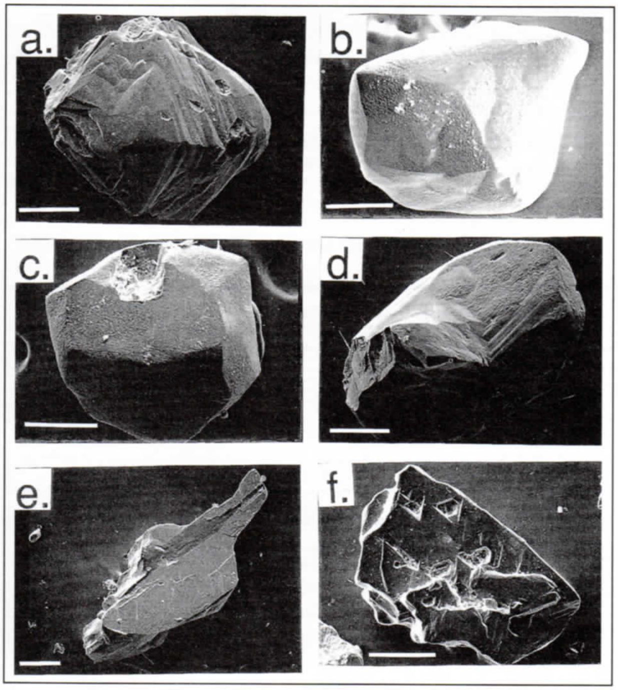

Figure 3. Highly resorbed diamonds, and fragments. **(a)** 1-2-43. Octahedron with parallel growth, low relief surfaces. **(b)** 1-2-4. Irregular with low relief surfaces (shagreen), lamination lines. **(c)** 1-2-2. Tetrahexahedroid twin with hillocks, inclusion pits. **(d)** 1-3-29. Tetrahexahedroid macle twin with low relief surfaces, uneven resorption. **(e)** 1-3-24. Fragment with unresorbed breakage surfaces, fragile extension of diamond. **(f)** 1-2-29. Fragment with hexagonal pits containing secondary material. All scale bars 200 microns.

3.1(b) Resorption

Robinson (1979), recognised that certain surface textures were restricted to octahedral, cubic or tetrahexahedroid surfaces, and that a distinct series of surface textures results from the resorption of octahedral and cubic diamond to the rounded tetrahexahedron (tetrahexahedroid; Robinson *et al.,* 1989). Octahedral surfaces uniquely exhibit trigonal pits, for example (Fig. 2f), and when pitting is present, cubic surfaces typically have tetragonal pits (Fig. 2a,b,d,e). Tetrahexahedroidal surfaces exhibit hillocks as the most common surface texture as resorption proceeds on octahedral (Fig. 1b,d) and cubic diamonds (Fig. 2a,b). Complete resorption of a cube or octahedron results in the formation of the tetrahexahedroid, and in diamonds from kimberlites, all surfaces are usually covered by hillocks. If resorption is particularly long or severe, the hillocks may be subdued (Fig. 3b) and the result is a pseudo-tetrahexahedroid with low-relief surfaces (Fig. 2c,3a). McCandless *et al.* (1994) noted that low-relief surfaces dominate on macrodiamonds from the Prairie Creek lamproite, and appeared to dominate on diamonds from Ellendale lamproites (McCandless and Gurney, 1995). This suggests that resorption may be more severe in lamproites, resulting in a greater proportion of tetrahexahedroida with low-relief surfaces. Low-relief surfaces and hillocks are also more commonly seen on macrodiamonds (>1 mm) than on microdiamonds, although there are exceptions in this study (Fig. 3a,b). In contrast, Robinson (1979) recognised several surface features that are very common amongst diamonds from xenoliths (most of which are less than 1 mm in size). These include knob-like asperities (Fig. 2d,4c), serrate laminae (Fig. 1a,4e), tetragonal pitting (Fig. 4a,c,e) and crescentic steps (Fig. 1c,2e). These surface textures result when resorbing volatiles in the host lamproite or kimberlite have restricted access to the diamonds due to adjoining mineral phases. McCandless *et al.* (1994) grouped these surfaces as xenocrystic surface features (xsf) and noted that they dominate amongst microdiamonds in Arkansas lamproites. Microdiamonds, and fragments derived from microdiamonds typically exhibit these surfaces (McCandless, 1989; McCandless and Gurney, 1995). In this study, this terminology is continued, and we add to it by defining hillocks and low-relief surfaces as macrocrystic surface features (msf). In this way, it is possible to make a qualitative distinction between diamonds that derive from disaggregation of macrodiamonds, and those that derive from disaggregation of microdiamonds that were shielded in xenoliths until resorption had ceased. This does not imply that macrodiamonds are derived from parent rocks other than peridotite or eclogite, however.

A characteristic of the Dachine diamonds is the dominance of macrocrystic surface features, in particular, the low-relief surface (Figs. 1,2,3,4; 34 %; Table 2). This is also in contrast to microdiamond populations from kimberlites and lamproites where xenocrystic surfaces dominate (~90 %; McCandless and Gurney, 1995). Low-relief surfaces are the most dominant resorption surface of diamonds from lamproites such as at Prairie Creek, where it is present on 94 % of the macrodiamonds (McCandless *et al.,* 1994). The similarities suggest that the Dachine diamonds may have been derived from a lamproitic igneous host, or at the least, an igneous host with volatile compositions (i.e. H_2O/CO_2 ratios) similar to lamproites. It also suggests that the majority of fragments are derived from larger stones, i.e. from macrodiamonds, in comparison to other kimberlite and lamproite localities where xenocrystic surface features dominate (McCandless *et al.,* 1994; McCandless and Gurney, 1995).

Four groups, based mainly on colour, surface features, and morphology, were defined in an attempt to identify the possible

Table 1. Classification scheme for microdiamonds using morphology and surface features. Modified from McCandless *et al.* (1994)

IF >50% OF DIAMOND CRYSTAL IS PRESERVED WITH SURFACES MAINLY:	THEN THE SHAPE IS A:
cubic surface features	cube
cube-octahedral surface features	cube-octahedron (c-oct)
octahedral surface features	octahedron
tetrahexahedroidal surface features	tetrahexahedroid
dodecahedral surface features	dodecahedron
IF <50 % OF DIAMOND CRYSTAL IS PRESERVED WITH SURFACES MAINLY:	**THEN THE SHAPE IS A:**
>50 % cubic surfaces (tetragonal pits, pointed plates, cresentic steps	cubic surface fragment (cubef)
>50 % octahedral surfaces (trigons, shield/serrate laminae, triangular plates, hexagonal pits)	octahedral surface fragment (octf)
>50 % cube-octahedral surfaces (combinations of the above)	cube-octahedral surface fragment (c-octf)
>50 % tetrahexahedroidal surfaces (hillocks, low-relief surfaces, terraces shagreen corrosion sculpture)	tetrahexahedroidal surface fragment (thhf)
>50 % dodecahedral surfaces (ribbing, knob-like asperities)	dodecahedral surface fragment (dodf)
>50 % breakage surfaces (cleavage, subconchoidal breaks)	fragments (frag)

Table 2. Physical characteristics of microdiamonds from Dachine. Shape and surface feature abbreviations are defined in Table 1.

¹shapes as % of whole crystals only				
octahedra	**octahedral aggregates**	**cubes**	**cube-octahedra**	**tetrahexahedroida**
33 %	17 %	15 %	18 %	16 %
²fragments as % of total population				
octahedral fragments	**cube-fragments**	**frags**	**cube-oct fragments**	**tetrahexahedroida fragments**
26 %	3 %	38 %	<1 %	5 %
³surface features				
xenocrystic surfaces (xsf)	**macrocrystic surfaces (msf)**	**breakage surfaces**	**hillocks**	**low relief surfaces**
29 %	60 %	11 %	22 %	34 %
⁴size in microns				
200	**300**	**400**	**500**	**>500**
10 %	37 %	41 %	5 %	7 %

1 – of the total population, only 27 % are whole stones. These are normalised back to 100 %.
2 – the remaining 73 % of the diamond population is represented here.
3 – note that some diamonds may exhibit more than one surface feature, hence total is greater than 100 %.
4 – size is approximated using average of longest and shortest dimensions.

parageneses that might be present (Table 3). (1) Small to mid-size (200-600 microns diameter) off-white to white, inclusion-bearing octahedra, cubes, and fragments in which xenocrystic surface features dominate; (2) Large (300-1000 microns) brown, heavily included octahedra and tetrahexahedroida, and derivative fragments, with macrodiamond surface features dominating; (3) Small (200-600 microns) white to off-white, slightly included single octahedra, cubes, tetrahexahedroida, and derivative fragments mainly with macrodiamond surface features dominating; (4) Small to mid-size (200-600 microns), apparently body-coloured stones, including pale pink, green, yellow, and gray octahedra, cubes, and tetrahexahedroida.

Group 1 is assumed to represent diamonds derived mainly from xenolithic material, whereas groups 2 and 3 may represent macrodiamonds from a variety of sources. Group 2 diamonds have about twice the percentage of diamonds greater than 400 microns compared to groups 1,3 and 4 (Table 3). The brown colour of diamonds in group 2 may be due in part to the abundance of black-brown inclusions. Group 2 also includes more fragments than group 1, which would be anticipated if group 2 diamonds are the fragments of larger, inclusion-bearing diamonds, making them more susceptible to breakdown due to internal stresses. The difference in inclusion abundance, size and morphology for the diamonds comprising group 1 and 2 suggests that at least two diamond parageneses may be present in the igneous host. One paragenesis consists of larger, heavily included diamonds and the other consists of smaller, less included diamonds. The variety of body colours that comprise group 4 diamonds probably represents a number of other minor parageneses.

During resorption, larger diamonds are exposed early on and experience the greatest amount of resorption (Fig.1b,d,e). This is supported by the positive correlation between the percentage of stones >400 microns in size, and the percentage of macrocrystic surface features present, particularly for groups 2 and 3 (Table 2). Diamonds break during resorption and it appears that most breakage surfaces have some evidence of resorption (Fig. 1f,3e,f). Smaller diamonds may exhibit xenocrystic surface features as described previously (Fig. 1c,2d,4a,c,e) and may even have uneven resorption, which occurs when parts of the diamond are exposed at different periods in the resorption process (Fig. 1b). However, some of the largest diamonds exhibit xenocrystic surface features, and some are relatively inclusion-free group 1 diamonds (Fig.1a, 4f). These are the most attractive with respect to colour and the lack of inclusions.

Table 3. General characteristics of the diamond groups. See text for discussion.

size in microns			
	<300μ	**>300μ**	**>400μ**
group 1	54 %	46 %	11 %
group 2	50 %	50 %	23 %
group 3	43 %	57 %	11 %
group 4	43 %	57 %	13 %
surface features			
	% of fragments	**% w/xenocrystic surfaces**	**% w/macrocrystic surfaces**
group 1	70 %	78 %	6 %
group 2	89 %	30 %	57 %
group 3	81 %	<1 %	92 %
group 4	81 %	36 %	54 %

3.1(c) Weathering processes

Diamonds at surface conditions are under high internal stress due to expansion of included minerals. This leads to fracture and disaggregation, which is the most dominant weathering process for the Dachine diamonds. This process is independent of whether the diamonds are transported, and can occur in situ in the igneous host. Once exposed to meteoric water, the inclusions in the diamonds are altered to secondary material comprised of Fe-oxide/hydroxides and clays (Fig. 1d,3c,3f). Indentations in irregularly-shaped diamonds were previously occupied by other primary minerals that protected these areas until resorption ceased. Weathering removes these adjoining minerals, leaving unresorbed low areas of diamond surrounded by high points with low-relief surfaces (Fig. 4d). Primary inclusions or intergrowths of other minerals with the diamonds are very rare, being observed only on two diamonds. In Fig. 4b, the intergrowth/inclusion exhibits a corrosion texture that is typical of silicates exposed to lateritization or calcretization, indicating that the diamonds have been in a weathering environment dominated by chemical weathering.

Although the green and yellow colours of some diamonds appear to be body colours, it is possible that the green and yellow colouration is due to surface staining by Fe-oxide/hydroxide minerals during weathering or to radiation damage by uranium in groundwater.

3.1(d) Transport features

None of the diamond populations bear resemblance to diamonds derived from alluvial sources i.e., where the diamonds have traveled far from their igneous host. There are also a number of fragile fragments with thin extensions of diamond bounded by breakage surfaces, that would not survive transport under typical fluvial bedload conditions (Fig. 3e). Some of the largest diamonds are also cracked octahedra (Fig. 4f) that could not travel far in a bedload environment before breaking down. Although the composition of the fluvial bedload (e.g. gravels *vs* silts) plays a significant role in the severity of mineral wear during transport (McCandless, 1990), it was possible to establish that the Dachine diamonds were not far removed from their source, which was later confirmed (Bailey *et al.,* 1998).

3.2 Carbon isotopes

By analysing the silicate and oxide inclusions found in diamonds, it has been established that most diamonds originate in either mantle peridotite or mantle eclogite. Worldwide, many diamonds with eclogitic and peridotitic inclusions have been analysed for carbon isotopes, and these data are compiled in Fig. 5. Peridotitic diamonds have a narrow carbon isotopic range with most values between 0 and -10 ‰. Eclogitic diamonds have a broader range with many values from -10 to -30 ‰. Thus, the carbon isotope ratios of diamonds with unknown paragenesis that fall within the range 0 to -10 ‰ may be either eclogitic or peridotitic, whereas diamonds with values less than -10 ‰ are considered to be from eclogite. Only two diamonds from Dachine have values near -10 ‰, the rest are less than -11 ‰, with a cluster of values around -25 ‰ (Fig. 5a).

Three octahedra, one cube and one cube-octahedron were analysed from group 1. Four of the diamonds are ^{13}C-depleted, with $\delta^{13}C$ ratios centred at -27 ‰, and one octahedron is heavier at -12.6 ‰ (Fig. 6a). Group 1 diamonds are dominated by xenocrystic surface features and it was anticipated that these diamonds may be eclogitic. An octahedron and a cube-octahedral fragment from group 2 give two of the most ^{13}C-depleted results, -28.9 and -26.3, respectively. The heaviest diamonds are found in group 3, with three of 10 diamonds between -8 and -13.7 ‰ (Fig. 6a; Table 4). The remaining diamonds in group 3 are ^{13}C-depleted with $\delta^{13}C$ ratios centred around -25 ‰ (Fig. 6a). In the group 4 diamonds, a cube, octahedral fragment, and tetrahexahedroidal fragment centre around -26 ‰, a fragment, an irregular and an octahedron have heavier values of -19.4, -17.0, and -19.4 ‰, respectively.

The results suggest that the Dachine diamonds are derived from eclogitic parent rocks, with 15 of 22 diamonds having $\delta^{13}C$ ratios less than -20 ‰. Four of the diamonds within this range are the xenocrystic diamonds of group 1. Of the six group 3 diamonds that fall within this range, one is distorted and exhibits ribbing (Fig. 2e), which also supports a xenocrystic origin. One group 4 diamond within this range exhibits lamination lines (Fig. 1f), also supporting a xenolith origin. Though not conclusive, the features suggest that many of the diamonds that exhibit macrocrystic surfaces in group 3 are possibly derived from the same source as the xenocrystic diamonds of group 1. Three diamonds in group 3 cluster at isotopically heavier values from -8.1 to -13.7 ‰ (Fig. 5a). These diamonds may represent a different paragenesis, as they are whole crystals that are ≥200 microns in size and exhibit macrocrystic surface features (Table 4). Uneven resorption on the isotopically heaviest diamond still supports a xenocryst origin for these diamonds (Fig.1b; Table 4). Three group 4 diamonds that fall in the range from -15 to -20 ‰ include a yellow cube, a pink octahedral fragment, and a green tetrahexahedroidal fragment (Fig. 6a). Assuming these diamonds are all from the same source, this suggests that a variety of coloured diamonds occur in the same paragenesis.

Assuming size is a measure of the most important paragenesis economically, the largest diamonds analysed are an irregular fragment roughly 1000 microns in diameter with $\delta^{13}C$ = -23.3 ‰, and a brown octahedron with $\delta^{13}C$ = -26.3 ‰ (Fig. 6b; Table 4). The next largest diamonds are in the heavier range, and both are whole crystals (Fig. 6b). Thus from a size argument only, the more ^{13}C-depleted group is more important, because one 1000 micron diamond is a fragment of a larger crystal. The present database is otherwise too small to permit further interpretation.

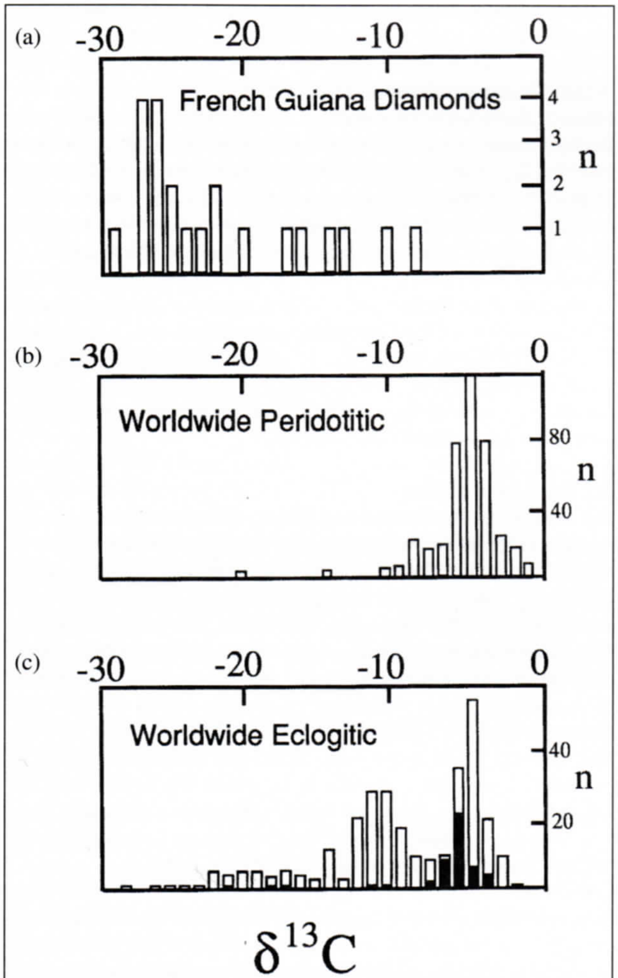

Figure 5. (a) Carbon isotopic compositions of microdiamonds from Dachine, French Guiana, compared to **(b)** peridotitic and **(c)** eclogitic diamonds worldwide, including diamonds from eclogite (shaded region; data from Kirkley *et al.*, 1991; and Deines *et al.*, 1993).

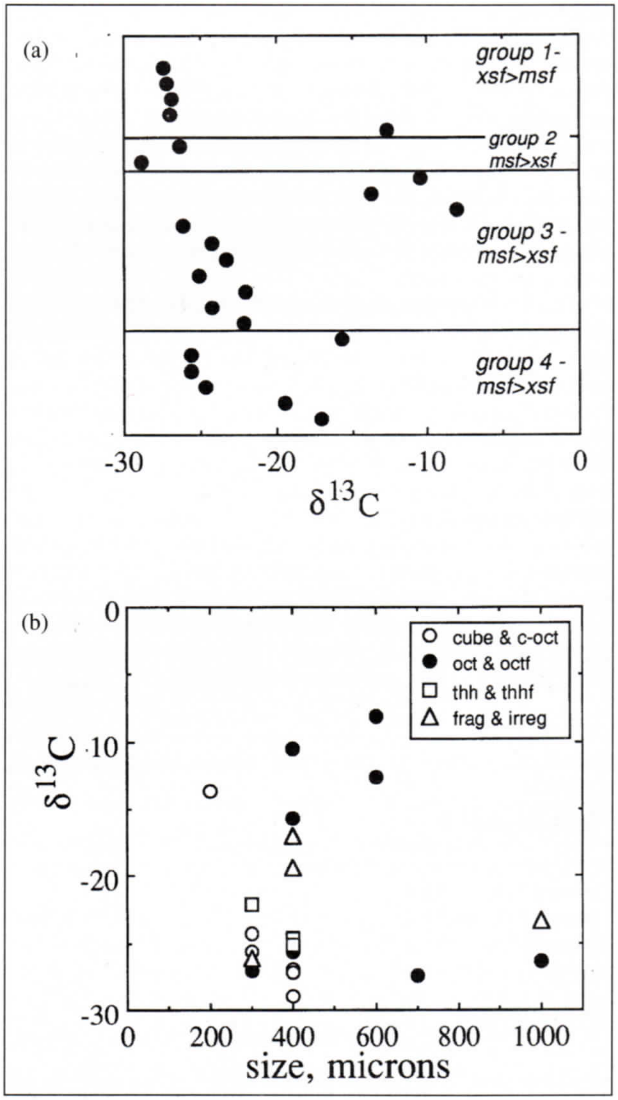

Figure 6 (a) Carbon isotope values for the four Dachine diamond groups, as defined in the text. **(b)** Size and carbon isotope isotope compositions. Abbreviations are as in Table 1.

4. DISCUSSION

There are a large number of cubes and cube-octahedra in the Dachine microdiamonds. Given that lamproitic/kimberlitic magmas attack diamonds vigorously, and peridotite xenoliths are more easily disaggregated than eclogite, it was considered that the cube diamonds survived because they were derived from eclogite. Group 1 diamonds are dominated by xenocrystic surface features and it was also anticipated that these diamonds may be eclogitic. However, the abundance of diamonds with ^{13}C-depleted signatures was not anticipated. The ^{13}C-depleted, eclogitic diamond is a minor component in most kimberlites, and in fact 75 % of all eclogitic diamonds fall within the range 0 to -12 ‰ (McCandless and Gurney, 1997). There are a number of exotic localities that have ^{13}C-depleted diamond populations. These include the alluvial carbonados from Brazil (-20 to -34 ‰), alluvial microdiamonds from Coanjula, Australia (-2 to -27 ‰; summarized in Chopin and Sobolev, 1995), microdiamonds from the Kamchatka Peninsula (-29-35 ‰; Kepezhinskas *et al.*, 1998), in ultra-high pressure terranes from Kazakhastan (Shatsky *et al.*, 1995), and graphite pseudomorphs after diamond in the Beni Bousera ultramafic massif, Morocco (-15 to -27; Pearson *et al.*, 1995). The diamonds from most of these localities have surface features that differ from those observed on diamonds from kimberlites and lamproites. In contrast, the Dachine diamonds have surface features that are consistent with derivation from mantle-derived parent rocks, in particular from eclogite, followed by resorption in a volatile-rich magma such as kimberlite or lamproite.

Table 4. Carbon isotope composition and other features of diamonds from French Guiana, arranged by group (gp).

group	sample	size	$\delta^{13}C$	color	shape	sf	Figure
4	1-2-4	400	-17.0	w	irr	msf	3b
4	1-2-43	400	-15.7	pale gr	oct	msf	3a
4	2-2-136	400	-19.4	y	frag	msf	
4	1-2-62	400	-24.7	gn	thhf	msf	1f
4	2-2-86	400	-25.6	pink	octf	msf	
4	1-2-1	300	-25.6	y	cube	msf	2a
3	1-2-2	300	-22.1	ow	thh	msf	3c
3	1-2-77	400	-25.1	ow	thhf	msf	
3	1-2-82	1000	-23.3	ow	irrf	msf	1e
3	2-2-71	300	-24.3	w	c-oct	msf	2e
3	1-2-206	300	-26.1	w	frag	msf	
3	1-3-45	600	-8.1	ow	oct	msf	1b
3	1-3-16	200	-13.7	ow/gra	cube	msf	2c
3	1-2-99	400	-10.5	w/g	octf	msf	
3	2-2-59	300	-22.2	ow	c-oct	msf	2f
2	1-2-101	400	-28.9	br	c-octf	xsf	
2	2-2-122	1000	-26.3	br	oct	msf	
1	1-2-81	600	-12.6	w	oct	xsf	1a
1	1-2-108	700	-27.4	ow	oct	xsf	4f
1	2-2-14	300	-27.0	ow	oct	xsf	4a
1	1-3-5	400	-26.9	w	c-oct	xsf	1c
1	2-2-138	400	-27.2	w	cube	xsf	2b

Key: w = white; y = yellow; ow = off-white; b, br = brown; gra, gr = gray; gn = green. Shape abbreviations are defined in Table 1. sf = surface features; xsf = xenocrystic surface features; msf = macrocrystic surface features. $\delta^{13}C$ is in per mil (‰) relative to PDB. Size is in microns.

5. CONCLUSIONS

Although the carbon isotopic signatures are unusually ^{13}C-depleted, the primary morphology and surface features suggest that the Dachine diamonds are derived from mantle sources, particularly from eclogite. Subsequently the microdiamonds were transported in a strongly resorbing host magma, such as a lamproite or other igneous host with a high H_2O/CO_2 ratio. The microdiamonds were exposed to chemical weathering, and transported a very short distance from their igneous host.

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