DIAMONDS FROM KIMBERLITE IN THE COLORADO-WYOMING STATE LINE DISTRICT

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Seventy-eight diamonds recovered from weathered kimberlite from diatremes in the Colorado-Wyoming State Line district are described in terms of size, weight, morphology, color, fluorescence and inclusions. The diamonds range from approximately 0.2 mm to 2.0 mm in average diameter and less than 0.5 mg to 11.8 mg in weight (McCallum and Mabarak, 1976a and b). The stones are subdivided into two groups: 1) "microdiamonds", those greater than approximately 1 mg and 1 mm (24), and 2) "minimicrodiamonds", those less than 1 mg and 1 mm (54)(Table 1). The total weight of the 78 diamonds is about 84 mg or approximately 0.42 carat. "Microdiamonds" comprise nearly 64 mg (0.32 carat) of the total whereas "minimicrodiamonds" account for the remaining 20 mg (0.10 carat) (Table 2, Fig. 1).

Morphological descriptions are based on the six-fold classification of Whitelock (1973) that categorizes diamonds as octahedra, rhombic dodecahedra, flattened dodecahedra, macles, aggregates and irregular shapes (formless and fragments), plus a seventh category of rounded crystals transitional between octahedra and dodecahedra. Aggregate types and octahedra predominate (27 and 18 respectively - Table 1, Fig. 2); most aggregates are comprised of octahedral forms and complex interpenetrations of octahedra. There is a progression between planar, laminated and distorted octahedra through rounded transitional octahedral-dodecahedral forms to rhombic dodecahedra to flattened dodecahedra. Octahedra are more abundant in the "minimicrodiamond" fraction and octahedra/dodecahedra ratios show a general decrease with size ("minimicrodiamond": $O/D = 6.0$, $O/D^{+} = 1.09$; "microdiamond": $O/D = 1.2$, $O/D^{+} = 0.67$) (Table 1, Fig. 2). Five flats (flattened dodecahedra) were found and three of these are in the larger size category; seven of the eight macles recovered fall into the smaller size category.

Many octahedral forms show a well developed lamellar buildup and presence of abundant triangular growth platelets and terraces on 111 surfaces. Triangular shaped, pyramidal or flat bottomed depressions (trigons) commonly occur on octahedral surfaces, and both regular and irregular shaped etch pits have been observed on many surfaces.

The diamonds are predominantly colorless to glassy although a few range from white to grayish white to pale brown, pale orange or pale yellow, and a few inclusion-rich crystals are nearly black (Table 3). The largest proportion of colorless crystals are in the macle and octahedral groups, along with aggregates that predominate in octahedral forms. Colored stones show a moderately even distribution among crystal types except for macles that are characteristically uncolored. Pale yellow coloration is restricted to stones having octahedral forms (chiefly in the transitional octahedra-dodecahedra group). There is a general tendency for the number of colored stones to increase with crystal size (Table 4). Colored crystals comprise approximately 15 percent of the lowest two size fractions (less than 0.5 mm), but increase to nearly 40 percent of the four larger size categories (0.5 - more than 2.0 mm).

Many of the diamonds show a pronounced fluorescence in ultraviolet light: pale to bright yellow colors predominate, although blue white and pale orange colors were also observed. More than half of the crystals (40), especially those in the "minimicrodiamond" category, are non-fluorescent (Table 5). Yellow shades of fluorescence are most predominant in octahedral forms (octahedra, transitional octahedra-dodecahedra, and intergrown octahedra in aggregate

crystals). Blue white colors are confined to transitional octahedra-dodecahedra and dodecahedra, whereas pale orange fluorescence occurs primarily in aggregates. Macles are consistently non-fluorescent, as are two-thirds of the untwinned octahedra.

Minute inclusions are abundant in many of the diamonds, and although definitive analytical work has not yet been completed, garnet, olivine and pyroxene have been tentatively identified. Small black platelets of graphite occur along cleavage planes in some crystals. The graphite inclusions all appear to be concentrated near the surface of crystals and are probably the result of graphitization of diamond along planes of weakness (stress planes). Numerous clear fluid inclusions are also present.

Most State Line district diamonds apparently formed originally as octahedra, many of which were later modified to dodecahedral forms. Macles also are considered to be primary forms.

References

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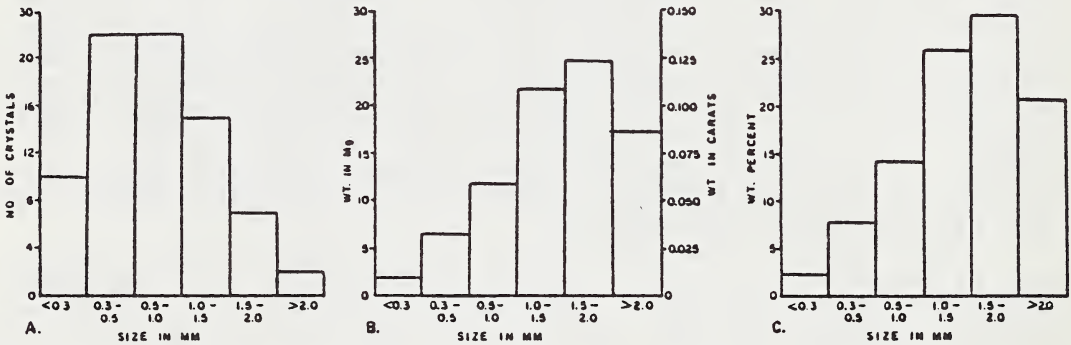

Figure 1. Size distribution of State line diamonds. A. Number of crystals per size interval. B. Weight per size interval. C. Weight percent of total per size interval.

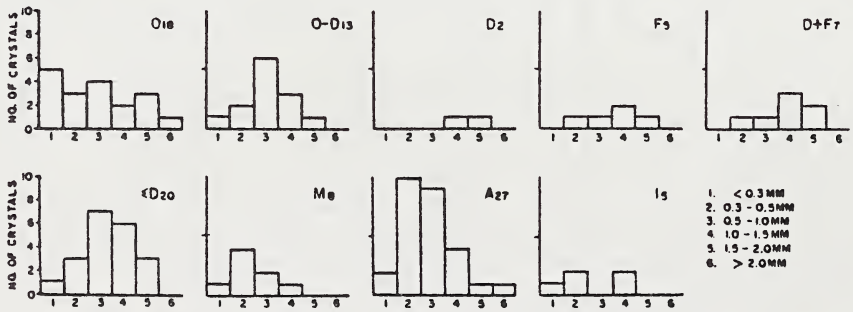

Figure 2. Crystal form as a function of size. Form symbols same as in Table 1 with the addition of D+F = dodecahedra and flats, and ΣD = total dodecahedral forms. Subscripts on form symbols indicate number of crystals of that type.

Table 1. Morphological calssification of State Line diamonds as a function of size. O = octahedra, O-D = transitional octahedra-dodecahedra, D = dodecahedra, F = flattened dodecahedra, M = macles, A = aggregates, I = irregular shapes, O/D = ratio of octahedra to dodecahedra, O/D* = ratio of octahedra to dodecahedra including O-D group with dodecahedra.

	Size mm*	O	O-D	D	F	M	A	I	Total	O/D	O/D*
"minimicro-diamonds"	0.3	5	1	0	0	1	2	1	10	---	5.0
	0.3-0.5	3	2	0	1	4	10	2	22	3.0	1.9
	0.5-1.0	4	6	0	1	2	9	0	22	4.0	0.57
Totals (ave.)		12	9	0	2	7	21	3	54	(6.0)	(1.09)
"micro-diamonds"	1.0-1.5	2	3	1	2	1	4	2	15	0.67	0.33
	1.5-2.0	3	1	1	1	0	1	0	7	1.5	1.0
	2.0	1	0	0	0	0	1	0	2	---	---
Totals (ave.)		6	4	2	3	1	6	2	24	(1.2)	(0.67
Overall Totals (ave.)		18	13	2	5	8	27	5	78	(2.57)	(0.90)

* Categorized according to largest dimension.

Table 2. Weight as a function of size

Size mm		no. of crystals	average weight		total weight	
			mg.	carat	mg.	carat
"minimicro-diamonds"	<0.3	10	~0.2	~0.001	~2.0	~0.010
	0.3-0.5	22	~0.3	~0.0015	~6.6	~0.033
	0.5-1.0	22	~0.54	~0.0027	~11.85	~0.059
Totals (ave.)		54	(~0.38)	(~0.0018)	~20.45	(~0.102)
"micro-diamonds"	1.0-1.5	15	1.55	0.0078	21.65	0.108
	1.5-2.0	7	3.09	0.0155	24.72	0.1236
	>2.0	2	8.72	0.0436	17.43	0.0872
Totals (ave.)		24	(2.60)	(0.013)	63.80	0.3188
Overall Totals (ave.)		78	(~2.37)	(~0.012)	~84.25	~0.421

Table 3. Color as a function of crystal form (form symbols same as in Table 1).

Color	O	O-D	D	F	M	A	I	Total
colorless to glassy	13	8	1	3	6	16	3	50
white	2	0	0	0	1	2	0	5
gray to gray white	0	0	0	0	1	5	0	6
pale brown	0	1	0	1	0	2	2	6
pale orange to orange brown	1	1	1	1	0	0	0	4
pale yellow	1	3	0	0	0	1	0	5
dark gray to black	1	0	0	0	0	1	0	2

Table 4. Color as a function of crystal size.

Size mm	colorless to glassy	white	gray to white*	pale brown	pale orange to orange brown	pale yellow	dark gray to black
0.3	12	1	0	0	0	0	0
0.3-0.5	13	1	3	2	0	0	0
0.5-1.0	10	3	1	1	2	4	1
1.0-1.5	8	0	2	1	1	1	1
1.5-2.0	5	0	0	2	1	0	0
2.0	2	0	0	0	0	0	0
Total	50	5	6	6	4	5	2

Table 5. Fluorescence as a function of crystal form (form symbols same as in Table 1).

Color	O	O-D	D	F	M	A	I	Total
yellow to bright yellow	3	2	0	1	0	5	2	13
pale yellow	3	6	0	2	0	3	1	15
blue white	0	2	1	0	0	0	0	3
pale orange	0	1	0	0	0	6	0	7
non-fluorescent*	12	2	1	2	8	13	2	40

* Most of the "minimicrodiamonds" are non-fluorescent or very weakly fluorescent.