Microdiamonds from the Sloan 1 and 2 Kimberlites, Colorado, USA

T. E. McCandless

Department of Geosciences, University of Arizona
Tucson, Arizona, 85721

Most macrodiamonds (>1 mm diameter) are considered to be from peridotitic or eclogitic regions in the mantle through which the kimberlite magma passes on its way to the surface. The diamonds are liberated from the eclogite and peridotite during emplacement of the kimberlite, and undergo resorption in the magma. Resorption systematically changes the diamond crystal from a primary octahedron to a tetrahexahedral shape with curved faces (tetrahexahedroid; Robinson, 1978, 1979). Smaller diamonds with higher surface area/mass ratios show greater degrees of resorption than larger ones. Microdiamonds (<1 mm diameter), however, are dominantly unresorbed octahedra, with tetrahexahedra being extremely rare. Microdiamonds may be from xenoliths which were efficiently shielded from resorption, or may represent phenocrysts in the kimberlite (Haggerty, 1986).

Microdiamonds from the Sloan 1 and 2 kimberlites have been examined in this study. The microdiamonds were recovered from 25-30 kilogram samples processed using bulk fusion techniques. A total of 562 microdiamonds from several samples were examined on binocular and scanning electron microscopes. These were classified as single octahedra, octahedral twins/aggregates, tetrahexahedroida, dodecahedra, and fragments, where fragments have <50% of crystal faces present. The results are compared to a representative subsample of macrodiamonds from Sloan 1 and 2 in Table 1. Only 1% of the microdiamonds are tetrahexadroida, whereas 40% of the macrodiamonds exhibit this habit. The octahedra/tetrahexahedra ratio (including twins) is 1.4:1 for the macrodiamonds versus 17:1 for the microdiamonds. Macles and aggregate octahedra are also very common, similar to observations made by McCallum et al., (1979) for microdiamonds from a number of kimberlites in the Colorado-Wyoming region, and for microdiamonds in diamond-bearing xenoliths (Robinson, 1979; Hall and Smith, 1984). Fragments are significantly more common in the microdiamond population. The high percentage may be due to processing of the kimberlite, which for some of the samples involved crushing and/or milling. Fragments are common amongst microdiamonds recovered from xenoliths, however, even in samples which were not crushed prior to acid digestion (Robinson, 1979). The microdiamond fragments were interpreted to be from cracked diamonds which occur within the xenoliths (Robinson, 1979). The fragments from the Sloan kimberlite samples are probably from diamond breakage during processing of the kimberlite and from cracked crystals within xenoliths.

The Sloan microdiamond habits consisting of unresorbed single, twin and aggregate octahedra, fragments, and rare tetrahexahedra are similar to habits observed for microdiamonds from xenoliths (Robinson, 1979; Hall and Smith, 1984). The similarity suggests that microdiamonds in kimberlite may originate from xenoliths which are disaggregated during emplacement of the kimberlite. From oxidation experiments on macrodiamonds, Cull and Meyer (1986) suggest that microdiamonds would totally disappear in a kimberlite magma of sufficiently high T and fO_2. Microdiamonds in kimberlite may either be shielded from resorption in xenolith material or be exposed to resorption and completely destroyed. Microdiamonds observed in kimberlites may therefore not require a phenocryst origin to explain their crystal shapes.

Table 1. Comparison of diamond habits for macrodiamonds (>1 mm;) and microdiamonds (<1 mm) from the Sloan 1 and 2 kimberlites.

	Macrodiamonds		Microdiamonds	
	N	% Total	N	% Total
Single Octahedra	560	51	35	6
Octahedral Twins/ Aggregates	70	6	48	8
Tetrahexahedra	355	32	5	1
Tetra. Twins/ Aggregates	91	8	0	0
Dodecahedra	0	0	2	<1
Fragments	26	2	471	84
Total	1102	100	561	100

Acknowledgements. — Thanks are extended to M.R. Wolfhard (Mobil Oil Corporation, Virginia) and M.A. Waldman (Lac Minerals, Colorado) for granting permission to publish this information. Thanks to H.H. Koehn, F. Meister, and O. Wilson for assistance on the SEM. Work was carried out at Superior Minerals, Tucson, Arizona, and Superior Oil, Houston, Texas.

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